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Hauling Out a Double Snag.

The United States Snag Boat.

THE SNAG BOATS OF THE SOUTH.—[See page 478.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, JUNE 9, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE SAN FRANCISCO EARTHQUAKE AND THE SENATE CANAL COMMITTEE.

The San Francisco earthquake is responsible for the Senate Committee on the Panama Canal having cast its vote, by a narrow margin of one, in favor of a sea-level canal. To those of us who have followed closely the course of the lengthy hearing before this committee, it was evident that there was a growing conviction that the lock canal was the better type to build, and it looked for a while as though there might be a nearly unanimous vote to this effect. The disaster of April 18, however, was bound to awaken solicitude as to the fate of locks and dams at Panama, in case a similar disturbance should visit the Isthmus after the canal was built; and the Senate Committee, by a vote of six to five, has committed itself to the sea-level canal, its decision being largely due to the imaginary dangers of earthquake.

We say "imaginary"; for as a matter of fact, and we wish to say this with all emphasis, the San Francisco earthquake, so far from shaking our faith in massive monolithic structures of the character that will be used for a lock canal at Panama, has triumphantly vindicated such structures, and proved that they can go through the severest earthquake practically unharmed.

For it so happens that there exist in the line of the main earthquake fault several large earth or cement structures of the same character, or built of the class of materials as it is supposed would be imperiled if the lock canal were subjected to earthquake shock. These structures form part of the extensive scheme of works by which San Francisco is supplied with water, and they include several large dams for the impounding of water. The most important of these, Pilarcitos Dam, is a mound of earth 120 feet in height and similar in construction to, though much lighter in its total mass and ability to resist destruction than, the Gatun Dam at Panama. Another important dam is that by which San Andreas Lake is formed, and this is a structure of earth and clay, approximately 100 feet in height above the natural surface of the ground. A third dam which came directly in the line of the earthquake fault was that at Crystal Spring. This is a concrete structure of unusually massive proportions, which extends to a height of 115 feet above the ground.

Now it is evident that the conditions were such that the passage of the main line of disturbance through the valley in which these structures have been erected afforded a colossal testing laboratory, in which the strength both of earth and concrete structures of great size was put to a full-sized test. What concrete and earth endured at these places under one of the severest earthquake shocks on record, they may be depended upon to endure again, and the lessons taught on that early morning of April 18 are good for all time and any place. The best description of the effect of the earthquake in this region is that given by Mr. Charles Derleth, Associate Professor of Structural Engineering at the University of California, whose observations are recorded in a recent article in the Engineering News. The Pilarcitos reservoir he found to be thoroughly intact and full of water, and its great earthen dam was not injuriously affected. Although the main fault line of the earthquake runs through Crystal Spring Lake, it appears to have in no way affected the imperviousness of its bottom, since the reservoir, two weeks after the earthquake, was found to be full of water. The fault line passes directly through the older dam, which separates the lake into two halves, yet the dam was not seriously affected. Again, it was found that though the line of disturbance touches the eastern edge of the San Andreas earth-and-clay dam, which is nearly 100 feet in height, and there is evidence that it was subjected to a most severe shock, it retains the water just as well as it did before the earthquake, and this in spite of the fact that there are cracks running through the ground against which the dam abuts. So again the concrete dam at Crystal Spring, 115 feet in height, shows not the slightest crack, although it was subjected to a series of thrusts and pulls in vertical planes along its axis.

It is impossible to resist the force of the argument that if these earthen dams in California could pass uninjured through the severe shock and wrenching to which they were subjected, the much more massive Gatun Dam, built in a region where shocks are infrequent and of comparatively moderate intensity, might be considered to be practically earthquake-proof. So again it may fairly well be argued that if a dam of simple concrete, 115 feet in height, endured the ordeal of the earthquake without developing a single crack, the 75-foot walls of the Gatun locks, built as they will be, not of simple concrete but of concrete stiffened, toughened, and thoroughly tied together with steel rods, and with a special eye to resisting earthquake stresses, will present no element of danger to the permanence of the canal.

STRENGTH OF THE JAPANESE NAVY.

An estimate of the strength of the Japanese navy, based upon the published statements of the Japanese themselves, shows that the total strength to-day, or one year after the close of the war, is represented by sixty-two ships of a total displacement of 356,871 tons. The general confidence in the accuracy of Japanese figures and statistics is based upon the veracity with which such information was given out during the operations of the war. Although important statistics were frequently withheld, such facts and figures as were made public proved to be remarkably correct.

The strength of the Japanese navy lies in its battleships and armored cruisers. In the former class the navy is represented by eleven ships of a total displacement of 154,268 tons. Among these are the four battleships the "Fuji," "Shikishima," "Asahi," and "Mikasa," which went through the war; five battleships captured from the enemy, namely, the "Iwami," "Sagami," "Tango," "Suwo," and "Hizen," and the two new battleships recently completed in England, the "Kashima" and "Katori," of 16,350 tons displacement, which are to-day the most powerful fighting ships afloat, carrying as they do, four 12-inch, four 10-inch, and twelve 6-inch guns.

The cruisers are divided into three classes, according to size. In the first class of 7,000 tons and upward, are ten armored cruisers, including the "Aso," captured from Russia, and the 13,000-ton "Tsukuba" built in Japan and approaching completion. In the second class are nine ships of from 3,500 to 7,000 tons, including the "Tsugaru," formerly the "Pallada," and the "Soya," formerly the "Variag"; and the third class contains eight third-class cruisers of less than 3,500 tons, making a total of twenty-eight cruisers, aggregating 249,274 tons.

The coast-defense fleet is made up of twelve ships, aggregating 43,191 tons, and in these are included the "Iki," formerly the "Nicolai I.," the "Okinoshima," formerly "Apraxin," and the "Mishima," formerly the "Seniavin." The balance of the fleet consists of seven gunboats, three dispatch boats, and a torpedo depot ship. Besides these sixty-two ships aggregating over 356,000 tons, the Japanese have thirty-four torpedo-boat destroyers and eighty-five torpedo boats.

In addition to the navy as given above, the Japanese have an aggregate of 97,000 tons of new ships either now under construction or to be immediately laid down. This includes two 19-000-ton first-class battleships, the "Aki" and "Satsuma," the former being built at Kure, and the latter at Yokosuka. The armored cruiser class is to be increased by four vessels, each of 13,000 tons, two of which have been launched, while the other two are under construction. Three third-class cruisers are also being constructed, each of which will be of 2,500 tons displacement and high speed. A significant fact in connection with the future development of this navy is that the Japanese now consider themselves to be independent of foreign shipyards, all of the new construction being built in Japanese yards.

DENATURIZED ALCOHOL.

The recent passage by Congress of the bill to remove the tax on alcohol for technical uses, is expected to prove of enormous value to almost all the industries of the country. To render unfit for drinking or other purposes alcohol which is intended for commercial or industrial utilization, the liquid must be "denaturized" by the addition of various substances which make it impossible of consumption in beverages.

Consul-General Thackara, of Berlin, writing on the use of denaturized alcohol in Germany for technical purposes, says that the subject was ably and exhaustively treated by his predecessor, Consul-General Mason, in various reports on the subject. He gives the following extract from one of Consul-General Mason's reports regarding the methods in use in Germany for the denaturization of alcohol:

For most industrial purposes alcohol is used in Germany duty free, after having been "denaturized" or rendered unfit for drinking purposes by admixture, in presence of a government official, with a prescribed percentage or proportion of one or more of several different substances prescribed in the very elaborate statue which governs the complicated subject in Germany. There are two general classes or degrees of denaturizing, viz., the "complete" and the "incomplete," according to the purposes for which the alcohol so denaturized is to be ultimately used.

Complete denaturization of alcohol by the German system is accomplished by the addition to every 100 liters (26½ gallons) of spirits: (*a*) Two and one-half liters of the "standard denaturizer," made of 4 parts of wood alcohol, 1 part of pyridin (a nitrogenous base obtained by distilling bone oil or coal tar), with the addition to each liter of 50 grammes of oil of lavender or rosemary; (*b*) one and one-fourth liters of the above "standard" and 2 liters of benzol, with every 100 liters of alcohol.

Of alcohol thus completely denaturized there was used in Germany during the campaign year 1903—4,931,406 hectoliters denaturized by process (*a*), as described above, and 52,764 hectoliters which had been denaturized by process (*b*). This made a total of 26,080,505 gallons of wholly denaturized spirits used during the year for heating, lighting, and various processes of manufacture.

Incomplete denaturization, i. e., sufficient to prevent alcohol from being drunk, but not to disqualify it from use for various special purposes, for which the wholly denaturized spirits would be unavailable, is accomplished by several methods, as follows, the quantity and nature of each substance given being the prescribed dose for each 100 liters (26½ gallons) of spirits: (*c*) Five liters of wood alcohol or one-half liter of pyridin; (*d*) 20 liters of solution of shellac, containing 1 part gum to 2 parts alcohol of 90 per cent purity (alcohol for the manufacture of celluloid and pegamoid is denaturized); (*e*) by the addition of 1 kilogramme camphor or 2 liters oil of turpentine, or one-half liter benzol to each 100 liters of spirits.

Alcohol to be used in the manufacture of ethers, aldehyde, agarcin, white lead, silver bromide gelatins, photographic papers and plates, electrode plates, collodion, salicylic acid and salts, aniline chemicals, and for a number of other purposes, is denaturized by the addition of (*f*) 10 liters sulphuric ether, or 1 liter of benzol, or one-half liter oil of turpentine, or 0.025 liter of animal oil.

For the manufacture of varnishes and inks alcohol is denaturized by the addition of oil of turpentine or animal oil, and, for the production of soda soaps, by the addition of 1 kilogramme of castor oil. Alcohol for the production of lanolin is prepared by adding 5 liters of benzine to each hectoliter of spirits.

The price of denaturized alcohol varies in the different States and provinces of the Empire in accordance with the yield and consequent market price of potatoes, grain, and other materials. At the present time alcohol of 95 per cent purity, which is the quality ordinarily used in Germany for burning, sells at wholesale from 28 to 29 pfennigs (6.67 to 6.9 cents) per liter (1.06 quarts), and at retail for 33 pfennigs (7.85 cents) per liter.

SOME FACTS ABOUT PORTLAND CEMENT.

The use of cement runs back to antiquity. There is no exact known date when mankind first used calcined limestone in connection with masonry. It is known to have been used anciently by the Chaldeans, Egyptians, Greeks, and Romans. The most ancient form of cement was simply burnt limestone, more or less pure, used very much as we use ordinary lime at the present time. The Romans were the first to adulterate lime by adding certain clay soils and slate for the purpose of making a cement of a hydraulic nature, i. e., one which would set or harden under water. Pliny, who lived in the first century B. C., describes the method of modifying ordinary burnt limestone and converting it into a form of hydraulic cement.

It was anciently believed that the best cement was made from the hardest rock, and this opinion was not modified from the time of the Romans down to the eighteenth century. However, John Smeaton, the man who built the second Eddystone lighthouse, in the course of examining the various hydraulic cements for use in the foundation and masonry, made the important discovery that the quality of hydraulic cement depends upon the amount of clay in the limestone. This is conceded as the most important discovery in the art in nearly twenty centuries.

On the island of Portland in the south of England there are certain quarries of limestone which have been worked for many years, anciently producing building stone. In 1824 an Englishman named Joseph Aspdin, of Leeds, patented a process for mixing and burning lime and clay. The product looked so much

like the Portland limestone that he called it "Portland cement," from which the commonly known name given to nearly all kinds of hydraulic cement was derived. From Aspdin's time to 1880 many mills were erected in England and on the Continent for making Portland cement, which was mostly poor stuff and of limited use.

The first Portland cement made in the United States was made by the Copley Cement Company, Copley, Pa., in 1875; their annual rate of production was 2,000 barrels.

It is not necessary to go into details here with reference to the manufacture and chemical composition of Portland cement, more than to state that the substance known as Portland cement consists largely of limestone with the addition of some silicate such as clay in certain proportions. In the process of manufacture these substances are crushed, introduced into rotary kilns under high temperature, and burnt together. The resulting clinker is taken and ground in some sort of ball or Griffin mill. It is necessary to grind cement to a very high degree of fineness, and its strength depends largely upon the degree of care with which this is done. It may be said that the modern cement mill is equipped with the machinery to do this suitably, as the requirements of engineers demand various tests before allowing cement to go into any work of importance.

The growth of Portland cement making in the United States has been rapid. In 1875 the annual production was 2,000 barrels per year; in 1890 (fifteen years later) it was 335,500 barrels; in 1900, 8,482,020 barrels; and in 1903 it was 22,342,973 barrels.

The importance of cement in the business world to-day is so great that not only have the different governments throughout the world taken up the matter of standardizing the tests determining the quality of cement, but it has also been done by various great engineering societies. Probably the standard work for testing cement is the publication issued by the Corps of Engineers United States Army entitled "Professional Papers 28." This pamphlet has been reprinted many times by private firms and translated into many languages.

The cost of Portland cement has annually decreased as the production increased, coming down from about $2.30 per barrel in 1890 to about $1.60 per barrel in 1900.

EHRLICH'S REMARKABLE STUDIES OF CANCER IN MICE.

The inoculation of mice with cancer is being practised on a very large scale by Prof. Ehrlich, of the Frankfurt Institute for Experimental Therapeutics.

The principal forms of malignant tumor are carcinoma, or true cancer, and sarcoma. Carcinoma occurs only in epithelium, the most important constituent of the glands and the outer layers of the skin; sarcoma only in connective tissue, which is found throughout the body. In man, mixed tumors (part sarcoma and part carcinoma) are very rare, and in mice they have never been known to occur spontaneously. But at Frankfurt a carcinoma that had remained true to type through nine inoculations, began to develop. The microscopical structure of sarcoma in the tenth mouse inoculated, became converted into a pure sarcoma in the fourteenth, and so remained during fifty subsequent inoculations. In another case a like change occurred suddenly, the characteristics of a mixed tumor appearing only in a single generation, the sixty-eighth. In a third case the mixed type seems to be permanent.

According to current theories carcinoma cells cannot change directly into sarcoma cells. The most plausible explanation of the transformation is that chemical changes in the carcinoma cells cause, through irritation, sarcomatous degeneration in the connective tissue and that the original carcinoma is crowded out by the more rapidly growing sarcoma.

Tissues and cells, whether normal or morbid, can be transplanted with success only from one animal to another of the same species or a species which forms hybrids therewith. Mouse cancer, for example, can be transmitted, permanently, to mice only. Nevertheless, if a rat is inoculated with very virulent cancer from a mouse, a tumor is produced which attains large size in a week, then diminishes, and usually vanishes entirely within three weeks after inoculation. Inoculations made from this tumor at the time of its greatest development have no effect on other rats but develop cancer in mice.

These facts cannot be explained by the assumption of a natural or "passive" immunity due to the preexistence of antitoxins in the rat's body, for such antitoxins would destroy the germs of mouse cancer on their introduction and the temporary swelling would not occur. An "active" immunity is certainly produced by the formation of antitoxins after, and because of, the inoculation, for a second inoculation fails to cause even temporary swelling. But this hardly suffices to account for the absorption and disappearance of the tumor, in view of the fact that the latter retains sufficient virulence to infect mice inoculated with it.

Ehrlich therefore has been led to the conception of "atreptic" immunity, or immunity due to starvation of the cancer cells. He assumes that the cell of mouse cancer requires for its growth, in addition to the general nutriment which is furnished in abundance by the rat as well as the mouse, a special nutriment which is found only in mice. The small quantity of this substance which is transferred to the rat, together with the cancer cells, in the act of inoculation maintains the growth and multiplication of those cells for a short time, but when the nutriment thus introduced has been consumed, the growth of the tumor necessarily ceases. After this moment, therefore, inoculation of a second rat with cells from this tumor can have only a negative result, because more of the special nutriment remains to be transferred with the cells, but a similar inoculation produces a rapid cancerous growth in a mouse, the body of which contains the special nutriment in abundance.

This theory also explains the often observed fact, that in a mouse in which a large tumor has been produced by inoculation a second tumor cannot be produced by inoculation from the first one. For, as the first tumor has grown rapidly and is well provided with blood vessels, it has so nearly exhausted the supply of the specific nutriment contained in the blood of the animal that the second inoculation falls, so to speak, upon barren soil.

Ehrlich explains the growth of tumors, according to the modern cell theory, by assuming that the morbid cells surpass the normal cells in the power to seize and appropriate food. Now comparatively few of the tumors which occur spontaneously in mice are transmissible to other mice by inoculation. The cells of most varieties of tumors, therefore, have no such advantage over the ordinary cells, and the spontaneous occurrence of a non-transmissible tumor is due, not to an increase in the assimilating power of the cells of which it is composed, but to a diminution in the assimilating power of the ordinary cells, that is to say, to the general debility of that individual mouse. This view is in perfect accordance with the facts learned by experience, that human cancer is most prevalent in advanced age, when the entire organism is debilitated, and that hereditary and constitutional peculiarities are also important factors in its causation.

The tumors of mice show great differences in virulence, as appears from the ease, difficulty, or impossibility of transmitting them by inoculation. Most spontaneous cases of carcinoma in mice cannot be transmitted at all, but the most virulent cases often give 100 per cent of successful inoculations. Ehrlich has proved, however, that inoculation from an ordinary, non-transmissible tumor, though it does not reproduce that tumor, has the remarkable effect of making the inoculated mouse immune to subsequent inoculation with tumors of the most virulent type. This result makes it possible to make any mouse immune to carcinoma by repeated inoculations with non-virulent growths and it has been proved that this immunity is not specific, but includes every variety of malignant tumor of either epithelial or connective tissue that has been propagated at the Frankfurt Institute. It would, of course, be premature to draw from these very interesting discoveries the inference that an effective cure for human cancer is within reach, but these results indicate that the experimental investigation is tending in a direction which provides a more hopeful view of the solution of the cancer problem than has been afforded by all previous study of the subject.

CONCRETE: ITS RISE AND ITS APPLICATIONS.

The history of concrete dates back to the Roman period, and its growth seems to have followed and is proportional to the growth of the Portland cement industry. The word "concrete" to engineers and contractors has a very definite meaning, but to those not familiar with the subject, the word "concrete" often suggests a "tar sidewalk." Concrete is a substance composed of broken stone, sand, and cement, or sand, gravel, and cement mixed together with water in certain well-defined proportions determined by experience. The resulting mixture is a pasty, jelly-like substance, which can be placed in excavations or box-like forms and allowed to harden or "set," as it is called. In the course of twenty minutes or a half hour it will have undergone what is called the "initial set." In other words, it changes its physical condition from that of a semi-fluid to that of a solid, and while it is not then hard it is a solid. The hardness of the "permanent set" will depend on many things. With good cement this hardness will grow with age, and there are some cements which show from tests a continual growth in strength and hardness for many years. There are many cements called "quick-setting" cements, which take on a permanent set in a short time and show a high strength; but it has been determined by experience and tests, however, that quick-setting cements are not so good or stable in the end as the slow-setting article, which grows in strength indefinitely.

With the increased production of Portland cement the use of concrete has been rapidly growing, and to-day it is simply a question of expense, as concrete masonry can be built for very much less than stone masonry, the result being the marked displacement of the latter. It is used at the present time for making dwelling houses, factories, chimneys, dams, water tanks, railway ties, and fence posts. In fact, it is hard to name a structure in the present day that has not been built of concrete. The introduction of armored or reinforced concrete has still more widened its field of usefulness.

FLUID LENSES.

A report from Consul-General W. A. Rublee, at Vienna, states that after experiments extending over a number of years a Hungarian chemist has succeeded in producing optical lenses by a simple and cheap process, that are not only quite as good as the best massive glass lenses at present used, but that can be manufactured of a size three times as great as the largest homogeneous glass lens heretofore made.

The importance of this invention in the field of astronomy is obviously very considerable. The largest glass lens heretofore manufactured out of massive glass for astronomical purposes has a diameter of about 1.50 meters (4.92 feet), and it required several years to make it, while the price was several hundred thousands of marks (1 mark = 23.8 cents). Such a lens can be manufactured by the new process in a few weeks at a cost of 2,000 or 3,000 marks. The price of a glass lens of the best German manufacture, with a diameter of 25 centimeters (9.84 inches), is now about 7,000 marks, whereas the price of a similar lens made by the new process is about 150 marks. Lenses of smaller diameter for photographic purposes, for opera glasses, reading glasses, etc., can be produced at correspondingly smaller cost. The lens consists of a fluid substance inclosed between two unusually hard glass surfaces similar to watch crystals, in which the refractive power and other characteristic properties are so chosen that the glass surfaces not only serve to hold the fluid, but also combine with the fluid to overcome such defects as are scarcely to be avoided in ordinary lenses. It is for this reason also that the lens is achromatic.

The fluid contained in the lens is hermetically sealed, so that no air can enter and exercise a damaging effect. The fluid does not evaporate, and its composition is such that its properties are not affected by time or by temperature. The coefficient of expansion, both of the glass and of the fluid, is approximately the same between the temperatures of 15 deg. of cold to 60 deg. of heat. Another advantage of the lens is that, on account of the fact that the fluid is not dense and the glass crystals are thin, the whole lens combination through which the light must penetrate is very slight.

RESISTANCE OF THE HUMAN BODY TO AUTOMOBILE ACCIDENTS.

The remarkable increase in the number of heavy and high-speed automobiles has not been without its effect upon the number of casualties which the newspapers daily chronicle, and which the comic papers seem to find so amusing. Dr. E. M. Foote, of New York, has unconsciously added fuel to these numerous fires by the preparation of an elaborate paper on accidents occasioned by wheels, particularly by wheels provided with elastic tires. If a sportsmanlike chauffeur has any yearning to run down human beings without actually killing them, he has but to study Dr. Foote's paper.

Dr. Foote's investigations were undertaken after a rather remarkable accident. An automobile delivery truck weighing about two tons passed over the trunk of a ten-year-old child without occasioning death. An investigation conducted by Dr. Foote for determining the cause of this abnormal result, led him to consider in a human body extended on the ground a line which he terms the "line of mortal pressure." The position of this line is dependent upon a host of factors, such as the weight of the vehicle, the width and elasticity of the tire, the speed of the vehicle, condition of the ground, clothing of the victim, mechanical resistance of the bones, contraction of the muscles. If the wheel of a vehicle strikes that line, death will probably result.

WHY DO STARS SEEM RAYED?

An attempt to account for the familiar rayed or starlike appearance of the stars when seen by the naked eye is made by W. Holtz in an article on the "Appearance of Stars," which appeared in Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse. He finds that all stars show precisely the same rays, but that in the case of the brighter stars the rays are plainer and somewhat longer. It is further remarked that the rays seen by the left and right eyes differ, and that if the head be turned the rays are rotated in a corresponding manner. It is thus concluded that the source of the rays is not in the stars but in the eye itself, the middle of the retina being not perfectly homogeneous in its sensitiveness.

THE RECONSTRUCTED CHRISTIE RACER AND ITS RECORD AT THE AUTOMOBILE CARNIVAL.

On the last day of the auto carnival and open-air show at the Empire City track, Walter Christie ran his reconstructed 135-horse-power direct-drive racer twice around the mile track in 54 1-5 and 53 seconds respectively. The second figure ties the track record made by Oldfield in a Peerless racer on a specially prepared track at Los Angeles, Cal., two years ago. It is equivalent to a speed rate of 67.92 miles an hour.

Our illustrations show the appearance of the Christie racer and its motor at the present time. The machine holds the world's record for the mile for a 4-cylinder car, it having covered that distance in 35 1-5 seconds on a soft beach at Atlantic City last April, as against 39 seconds scored the same day by an 8-cylinder Darracq. It has therefore run at the rate of 102 miles an hour, as against 122 miles an hour made at Ormond in January by the latter French car. In rebuilding his racer, Mr. Christie aimed at getting as powerful a motor as possible between the two front wheels. In order to accomplish this he placed the cylinders at a slight angle, as this enabled him to set the cylinders close together at their bases and still have room for the greater diameter of the water jackets and the heads. Electrolytic copper water jackets were first used, but these developed leaks and were subsequently replaced by clamped sheet-metal jackets. The exhaust valves (which are very large, being 3⅛ inches in diameter) are in the center of the cylinder heads and are water-jacketed. Eight 1½-inch automatic, flat-seated inlet valves occupy the remainder of each flat cylinder head. Thus both the incoming and outgoing gases have a direct passage into and out of the cylinders. The spark plugs screw into inclined holes at the edge of the cylinder heads. The pistons have four plain compression rings with square ends. They are also inlaid with three wide bronze rings which form the bearing surface. The cylinders are of steel having a 7⅝-inch bore and stroke. A 2¾-inch crankshaft of chrome steel is used. The engine weighs complete only 470 pounds. In making the record at Florida, it turned up 1,125 R. P. M. The weight of the complete machine is only 1,800 pounds. The original Christie car was illustrated in the 1905 Automobile issue of the SCIENTIFIC AMERICAN.

An Automobile Obstacle Race. A Car Making a Quick Turn As It Passes Through a Line of Chairs.

The Four-Cylinder Engine of the Christie Racer, Showing the Exhaust Valve at the Top.

The Christie 135-Horse-Power Racer Which Recently Made a Record of a Mile in 35 1-5 Seconds.

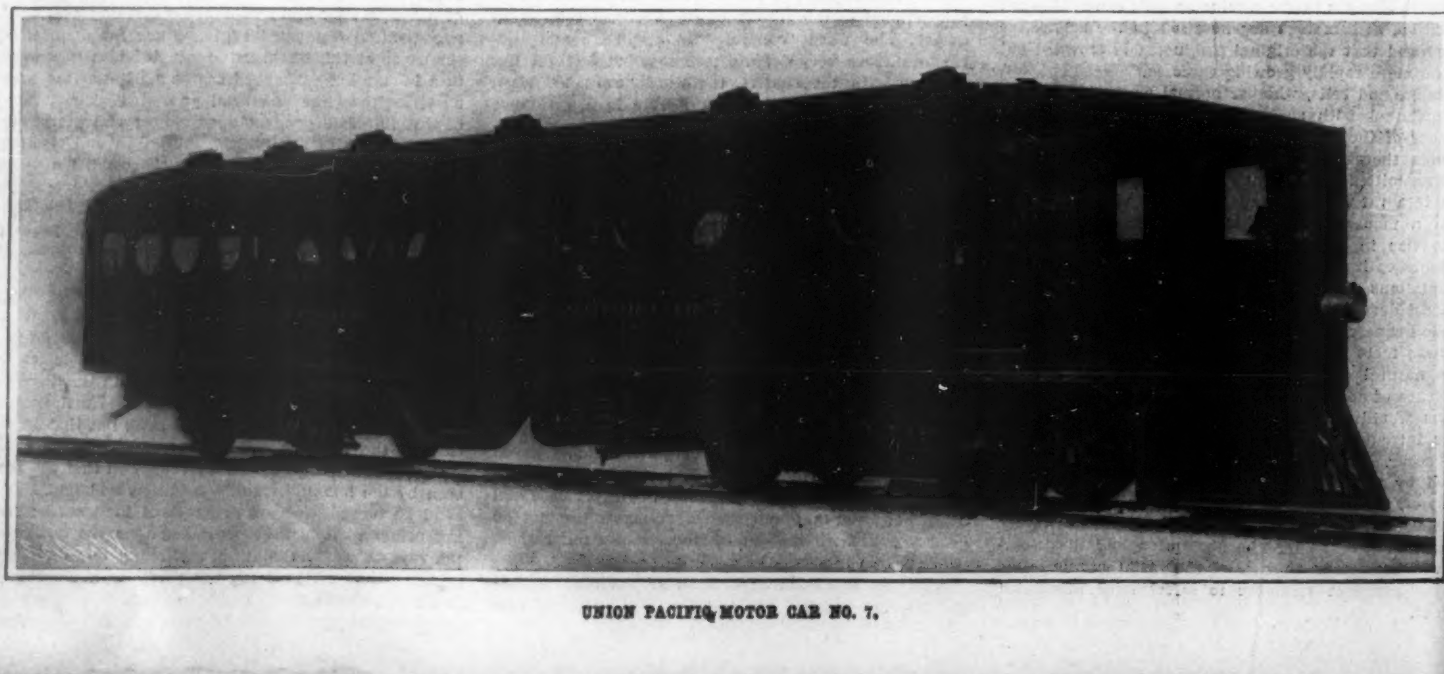
THE RECONSTRUCTED CHRISTIE RACER AND ITS RECORD AT THE AUTOMOBILE CARNIVAL.

Besides the record made by the Christie racer, several interesting tests were carried out. Among these were included a vibration test, a traction test, and an obstacle race. One of our illustrations shows a car making a quick turn while threading its way through a line of chairs in the last-named test. This test was won by a Maxwell runabout in 16 seconds, while a Wayne car was second in 16 1-5 seconds, and an Autocar third in 16 3-5. In the traction test each car was obliged to haul 500 pounds dead weight placed in a stone boat a distance of 200 yards. This was done by a 24-horse-power Autocar in 25 2-5 seconds, by a 24-horse-power Frayer-Miller in 28 4-5 seconds, and by a White steamer in 44 4-5 seconds. The vibration test consisted in carrying a pail filled with water a distance of 200 yards. The car was obliged to start from a standstill, and to cross the finishing line on high gear. The test was won by a 26-horse-power Oldsmobile with a loss of ⅝ inch of water. A 35-horse-power Gobron-Brillié was second with a loss of 6-8 inch, and a 40-horse-power Wayne third with a loss of ⅞ inch. One of the most interesting events was a one-mile race between two 10-horse-power single-cylinder Cadillac machines, each of which carried 10 passengers. The winner covered the mile in 2:46. A 3-mile match race was won in 4:04 4-5 by a 26-horse-power Oldsmobile, with two Ardsley machines second and third. A tug of war between a 24-horse power Autocar and a similar machine gave an effective demonstration of the efficiency of the single-disk clutch lined with cork, which seemed to hold better than the multiple-disk type of clutch used in the latter car.

UNION PACIFIC MOTOR CAR NO. 7.

The accompanying illustration is of the latest of the Union Pacific gasoline motor cars, constructed for suburban passenger traffic and inspection service on the lines of that road. While conforming in general to the plan of construction of its predecessors, all of which are now in successful operation on various parts of the Harriman railroad system, No. 7 shows numerous structural differences, which make it a decided improvement over the earlier designs. The car was built in the Omaha shops of the Union Pacific Railroad, and has recently undergone a series of successful tests between that city and Grand Island, in which it has demonstrated excellent hill-climbing ability over fairly stiff grades, and has developed a maximum speed of 53 miles an hour. The average speed for runs of four to five hours was from 34 to 36 miles.

The appearance of the car is attractive, and carries with it the appearance of being speedy. Among the conspicuous features of the design are the round, porthole-like windows, the sharp forward end tapered to a knife-like edge, and the convenient side entrances. The rear end, too, is rounded off as in the earlier motor cars, to avoid the vacuum created by a car with the usual square end. The door apertures for the side entrances are so constructed that by means of patented



UNION PACIFIC MOTOR CAR NO. 7.

steel framing the side of the car is in nowise weakened, as the depressed side sill is incorporated into the uninterrupted steel frame. By the slightly increased thickness of the side plates and the additional strength secured in this framing, a great increase in the general structural rigidity of the car is obtained. Notwithstanding that the roof is 9 inches lower than in the previous motor cars, the ventilation is said to be equally good. The square design of the window has been done away with, to allow the substitution of the round portholes, which are air, water, and dust proof. The appearance is similar to that of the porthole of a vessel, and the arrangement successfully gives protection against all the elements, a feature which is almost impossible to attain even with the double sash of the finest Pullman cars. By the use of the round windows, and the elimination of large wooden posts, a gain of 8 inches in the interior lateral dimensions is made.

The framework of the car is entirely of steel; the structure is 55 feet long over all, weighs 58,000 pounds, and has a seating capacity of seventy-five. The interior is handsomely finished in English oak with built-up veneered wood seats. The exterior construction has been designed throughout to avoid projections, which are apt to increase the friction of the air against the body, and such projections have been almost entirely eliminated, with the exception, of course, of the necessary ventilators on the roof.

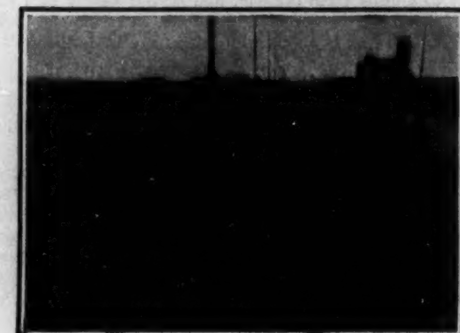
The engine is a six-cylinder, Standard gasoline motor located over the forward trucks, which are of special design to meet this requirement. An improvement in the construction of this car is the cast-steel "skirk," the engine-bed truck frame combination casting, which is a prominent factor in developing the practical side of the motor car for every-day service. The power of the engine is transmitted from the crankshaft by means of chain gearing, cast-steel gears being used for setting the car in motion. There are only two speeds; the first, in which the gears are employed, being up to 10 miles an hour. By means of an "octoroon" clutch, which may be thrown out of mesh, the engine is connected directly with the driving axle. The chain gearing is arranged for the second speed, up to 50 miles per hour. Compressed air is used for starting the engine, for operating the clutch mechanism and the air brake, and for whistle signals. An auxiliary air pump has been provided for emergency in case of shortage of the air, which is ordinarily supplied by a small air pump driven from the main engine crank-shaft. The air tanks, located under the body of the car, are of large capacity and of sufficient size for all ordinary requirements.

The controlling devices are of simple design, and are largely mechanical in operation. Special effort has been made to do away with the complicated machinery sometimes found necessary for the utilization of gas power in propelling railway motor cars. The equipment includes a powerful acetylene headlight and an acetylene gas system for interior illumination. The lamps for the latter purpose are provided with opalescent panels, which give a powerful light for reading purposes, while the general illumination of the car is subdued and restful to the eye. The accommodations for the passengers in general are simple, but comfortable. By improved engine construction, greater weight of the car, and increased rigidity of the framework, the unpleasant vibration often encountered in motor cars has been largely eliminated. By lengthening the car and providing double trucks the so-called "galloping" has been avoided.

THE EARTHQUAKE AND THE TRACKS OF A TROLLEY LINE.

Whatever seismologists may or may not know about the causes of earthquakes they are at least agreed that such displacements of the earth's crust as San Francisco recently witnessed are due to the sliding, bending, crumpling, and cracking of rocks. The origin of

Rails Buckled by the Earthquake.



Effect of Longitudinal Compression on Rails.

such a disturbance may be best described as a wrench which both compresses and distorts.

In the accompanying two illustrations, which were kindly furnished by a subscriber, the effects of the compression are admirably shown in the bending of the rails of a trolley line leading out of San Francisco. Each rail may be said to have been pushed longitudinally from each end, with the result that it bent. Hold one end of a wire in each hand; push your hands together, and a like effect will be produced. If the wire is very long it will buckle at several points. In the case of the railroad the buckling occurred over a distance of about three miles.

The accompanying photographs were taken about eleven miles south of San Francisco, entirely out of the influence of fire.

FIREPROOFING AT SAN FRANCISCO.

In speaking of the effects of the San Francisco disaster on buildings of steel and masonry, and the successful way in which, taken as a whole, they withstood the ordeal, a distinction should be made between the damage wrought by the earthquake and that due to the fire which followed. We have spoken in this journal of the triumphant manner in which such buildings withstood the disaster, and in using that term, we have had in our minds more particularly the earthquake shock, which seems to have had very slight visible effect upon buildings constructed on the skeleton-frame plan. As far as we have been able to learn, the wrenching and twisting did surprisingly little damage to these buildings, most of it being confined to the loosening, and in some cases throwing down, of portions of the tiling, brickwork, or other walling and partition material.

Of the effects of fire upon such buildings, and the way in which the different systems of fireproofing would withstand a fierce conflagration, there was not so much doubt; for when, some two years ago, the great fire at Baltimore swept through several modern skeleton steel buildings from basement to roof, many valuable lessons were learned as to the fire-resisting qualities of these structures. The earliest information received from San Francisco, whether from correspondents or in the form of photographs, showed that none of the steel buildings had been absolutely destroyed, and that most of them were standing apparently intact as to their steel framework. We have recently been favored, however, by Mr. D. W. Terwilliger, an architect of Los Angeles, Cal., with some very instructive photographs, showing the interior of some of the burned buildings, which were taken by him early in May. They prove conclusively that in the presence of a fierce fire, the integrity of the steel columns and floor beams is entirely dependent upon the quality of the so-called fireproofing in which they are incased. Where, as in the case of two of the columns, shown in our illustrations, there was no fireproofing, or the fireproofing was of a faulty character, the heat proved sufficient to reduce the strength of the metal to a point at which it crumpled up under the superimposed load, and the column sank bodily upon itself in its own axial line. That the subsidence of the columns should have taken place in such a true vertical direction is to be attributed to the fact that they were held in vertical line both at top and bottom by the ceiling and floor structure. Had all the columns on these particular floors been denuded of their fireproof material and exposed to the same heat, the whole building must inevitably have collapsed.

In our various articles on the fire we have strongly advocated the use of concrete as being the material which presents the most perfect fire-resisting qualities, and it so happens that in a comparison of two of the photographs sent us by our correspondent, our readers will find a most striking proof of the correctness of this view. We refer to the two views which were taken in the basement of the Ahrensen Building. Photograph No. 1 represents a steel column in this basement, which was supposed to have been rendered fireproof by incasing it in hollow tile. The tiling was stripped off by the heat, or possibly by the shock of the earthquake (although on this point we have no information), and under the weakening action of the fire the column has telescoped on itself for a distance of 10 or 12 inches. Sixteen feet distant from this column is another, which had been fireproofed by incasing it in concrete; but although it must have been exposed to the same shock and the same heat, the concrete is still in place, apparently in perfect condition, and the column within it is presumably uninjured. Just how great a heat it must have endured, may be judged by the condition of the sidewalk lights and beams, the beams being bent down, and the lights being partially melted and hanging from the beams like icicles.

On the first floor of this building was a corner store, which also shows the failure of the hollow tiling,

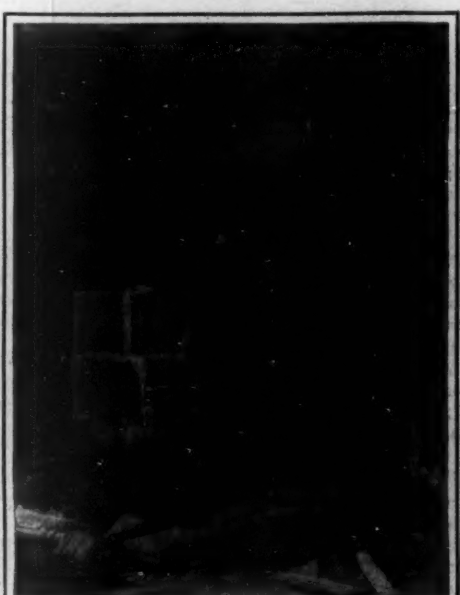


Fig. 1.—Column Incased in Hollow Tile, Stripped of Its Covering, and Buckled, Sinking 12 Inches.

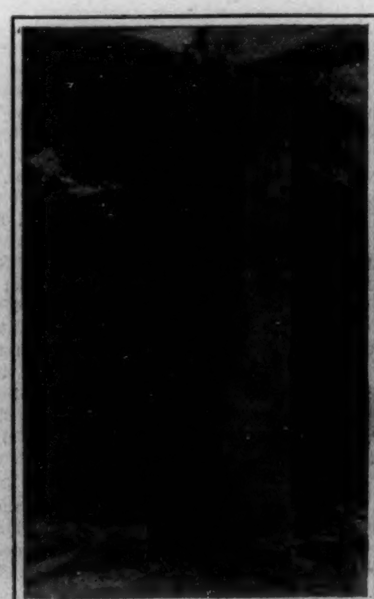


Fig. 2.—Column, 16 Feet from Column in Fig. 1. Incased in Concrete, Was Not Injured.

Fig. 3.—Non-Fireproofed Columns in Monadnock Building, Buckled and Shortened 10 Inches.

FIREPROOFING AT SAN FRANCISCO.

which was stripped from the columns and left the fire free to attack the columns. They telescoped in the same way as the columns in the basement, although in this case the collapse took place near the ceiling. An interesting fact brought out in this building is, that although the columns in some cases failed, the floors, the beams of which are incased in concrete, are apparently intact. Photograph No. 3 shows a similar failure of the so-called fireproofing on the columns in the basement of the ten-story Monadnock Building. Our correspondent also draws attention to the fact that in some of the buildings the rivets connecting the girders to the columns have apparently sheared off. The lesson of this last defect is that special attention should be paid to these connections, and extra heavy reinforcements, in the form of gussets and knee braces, should be worked in.

These views may be taken as a strong indorsement of the system of reinforced concrete, which, because of its homogeneous and monolithic character, presents ideal conditions of resistance both to the wrenching of an earthquake and the fierce ordeal of such a conflagration as destroyed San Francisco.

Return of Halley's Comet in 1910.

BY MARY PROCTOR.

Some interesting calculations have been made concerning the expected return of Halley's comet in the near future, by David Smart, F.R.A.S., and published in a late number of the Journal of the British Astronomical Society. Halley's comet is the first ascertained to move in an elliptical orbit, and it has a period of about seventy-six years, its periodicity having been discovered by Halley in 1681. It has since been observed in 1759, and again in 1835, and according to the calculations above referred to, which are founded on the best authority, will reach perihelion May 23, 1910.

The orbit of the comet in its outer part occupies a great circle as seen from the sun, passing 10 deg. south of Spica, then near Delta Corvi through Crater and Sextans, north of Alpha Hydræ, and close to Procyon, then north of Orion and Aldebaran to Delta Arietis. The greater part of the orbit is then south of the ecliptic, the ascending node being just outside Mars before reaching perihelion, and the descending node just inside the earth's orbit, after perihelion passage.

The speed at which the comet travels in its orbit varies tremendously from time to time, as the radius vector sweeps over equal areas in equal times, and the ellipse is a very elongated one. At aphelion the comet moves at 39 miles a minute, which is far more than we mentally associate with an "aphelion crawl."

Between aphelion and the orbit of Neptune the speed increases to 65 miles per minute, and between Neptune and the orbit of Uranus the speed equals 171 miles per minute. The comet is now about halfway between the orbits of Uranus and Saturn in a direction two degrees south of Epsilon Geminorum, its speed at present being 320 miles per minute. After it leaves the neighborhood of Saturn the comet will rush forward at the rate of 520 miles per minute until it passes the orbit of Jupiter and begins to approach Mars, when its speed will have increased to 783 miles per minute. Woe to any small asteroid it may encounter on its way, but worse still for the comet did it approach too near Jupiter, the great disturber of comets. However, on the comet's return journey, in 1909 it will not approach much within five times the earth's mean distance.

None of the other large planets comes anywhere near the comet on this trip, and in the case of Neptune this is fortunate, for when the elements of the 1910 orbit were computed, Neptune had not been discovered. (Date of the discovery of Neptune, September 23, 1846). Before perihelion the comet will be fairly near Mars.

At Mars's mean distance the speed will be 1,234 miles per minute, and at the earth's mean distance 1,548; while at perihelion the speed reaches its greatest value, namely, 1,878 miles per minute. Were this speed increased by about 17 miles per minute the orbit would become parabolic, and the comet would leave our solar system forever.

On May 22, 1910, or one day before perihelion, the comet and Venus will pass each other, on opposite tacks, at a distance of 0.245 unit. The comet will, as seen from Venus, pass within two degrees of the Pole Star. On June 12, 1910, the comet will make almost as close an approach to the earth, passing within five to ten million miles of the earth's orbit.

It is impossible to say anything as yet, regarding its position in the sky, as observable from the earth, until certain important computations have been made. A prize has been offered by the German Astronomical Society of 1,000 marks for the most exact calculation of the next appearance of Halley's comet. The paper may be written in English and need not be presented until the year 1908. When the orbit is computed we shall know exactly where to look for the comet. As seen from the sun its position at perihelion will be about four or five degrees from Theta Aquilæ, a distance equivalent to that separating the Pointers.

As to the appearance of the comet on its return, it depends entirely upon its position with regard to the earth and sun. If the earth is at a remote part of its orbit while the comet is passing the sun, it may be seen only with great difficulty, or even become quite invisible. On the other hand, if the earth happens to be near the comet about the time of its perihelion passage, when the comet's light is necessarily greatest and its train most extended, then a most favorable opportunity will be afforded for witnessing its physical appearance.

At its appearance in 1759, the comet had a train 50 degrees in length, and was best seen in the southern hemisphere. At its next return in 1835, it did not present the appearance of an extremely brilliant comet, but was reasonably conspicuous with a tail about 15 degrees in length. How it will look at its next return, it is impossible to conjecture.

At aphelion the comet reaches the immense distance of 35.2 units from the sun, and spends nearly half its time outside the orbit of Neptune. The sun as seen from aphelion is about a minute of arc in diameter, or about the apparent size of Venus at inferior conjunction. By viewing part of the sun's disk through a hole one-hundredth of an inch in diameter in a screen held three feet from the eye, we can get a good idea of how the sun looks from the comet at its greatest distance. According to Mr. Smart "the comet would be a grand place, as far as its orbit is concerned, for observing stellar parallax, but climatic conditions would not be favorable to observing. Only one year would be spent in each 75 in anything like sunshine, and near perihelion the telescope would probably appear as a bright line spectrum, and the observer as a hydro-carbon band."

The Current Supplement.

A new British, four-cylinder, balanced, compound "Atlantic" locomotive is described and illustrated in the opening article of the current Supplement, No. 1588. It is only in recent years that diametrical and circular pitches have come into serious collision in the machine shop. For that reason an excellent discussion of the subject in the current Supplement will be found of interest. Mr. Edwin C. Eckel's analysis of the cement materials and industry of the United States is continued. Mr. M. C. Miller tells in a very instructive way how the time tables of our great railroads are constructed. In an article entitled "Mechanics of Luminosity," the views of the modern English school of physicists are set forth. The physiological effect of life in the Alps is discussed. Mr. Friedrick Knauer presents many a bit of curious information on the ways of the ant. The astronomer and geologist ask but cannot decisively answer the question "How Old is the Earth?" That question Mr. Warren Upham has taken for the subject of his article, "Geological Time." The importance of oxygen is increasing so rapidly, that a paper on the commercial production of oxygen by the liquid air process, in which the work of Georges Claude is discussed at length, will be found of value. Mr. Maginnis's paper on Reservoir, Fountain, and Stylographic Pens is continued. For the average person the proper cooking of cereals is quite as important as the proportion of different nutrients which they contain. Hence an article on the subject which appears in the current Supplement should be read.

Official Meteorological Summary, New York, N. Y., May, 1906.

Atmospheric pressure: Highest, 30.49; date, 15th; lowest, 29.55; date, 3d; mean, 29.97. Temperature: Highest, 86; date, 18th; lowest, 40; date, 11th; mean of warmest day, 76; date, 18th; coldest day, 45; date, 10th; mean of maximum for the month, 70.3; mean of minimum, 53.3; absolute mean, 61.8; normal, 59.9; average daily excess compared with mean of 36 years, +1.9. Warmest mean temperature for May, 65, in 1880; coldest mean, 54, in 1882. Absolute maximum and minimum for this month for 36 years, 95, and 34. Precipitation: 4.67; greatest in 24 hours, 2.50; date, 27th and 28th; average for this month for 36 years, 3.15; excess, +1.52; greatest precipitation, 7.01, in 1901; least, 0.33, in 1903. Wind: Prevailing direction, south; total movement, 8,805 miles; average hourly velocity, 11.8 miles; maximum velocity, 48 miles per hour. Weather: Clear days, 15; partly cloudy, 7; cloudy, 9. Thunderstorms: Date, 2d, 5th, 11th, 17th, 18th, 27th. Frost: Light; date, 11th.

One of the most remarkable features in connection with gas engines for driving electrical generators is the great increase in alternating-current machines, and such increase is still rapidly continuing. To some extent this change has been unfortunate for gas-engine makers, owing to the greater difficulties in constructing suitable engines. As, however, in most instances such engines are required to be of considerable power, more than one cylinder would be required, for this reason, as well as to give greater regularity.

Correspondence.

The World's Iron Supply.

To the Editor of the Scientific American:

My attention has been attracted to an article in your issue of March 24, entitled "The Impending Exhaustion of the World's Iron Supply."

Allow me, through your columns, to inform those who are unnecessarily worrying themselves over this matter, that the already known iron deposits of Mexico, many of which are close to the sea, are ample in themselves to supply the iron furnaces of the world for at least the next half century, at the present rate of consumption. Moreover, our neighbor's mineral resources are as yet scarcely looked over, vast areas being unknown in detail to white men. I have spent the bulk of the last twelve months traveling in Mexico, from the Rio Grande to the Isthmus of Tehuantepec, and in that time have seen enough of available deposits of iron of excellent quality to calm all fears as to a possible scarcity of cheap ores of the metal.

Theo F. Van Wagenen.

Denver, Col., May 19, 1906.

The Earthquake at Napa, Cal.

To the Editor of the Scientific American:

In an article entitled "Earthquake Observations," published in the Scientific American of May 19, 1906, I notice the statement that Napa, Cal., was destroyed in the great earthquake of April 18. You will be conferring a favor on some of your readers if you will kindly publish the statement that *Napa was almost uninjured*. Several brick walls fell into the street, some stones fell from the face of one large building, many chimney tops came off, and some plastering fell from the walls. That is the extent of the damage here. Only two wooden buildings were moved. Their foundations were decayed and gave way, allowing them to drop down a couple of feet without hurting the people inside them. No one was killed here, and only one man hurt by falling bricks. In nearly seventy years of American settlement here no person has ever been killed by an earthquake, nor has any building ever been destroyed. Napa is forty-seven miles from San Francisco, and has felt every shock that has been recorded in the city, yet without damage except as above noted. Compare that with the loss by lightning in any town in the Eastern States. Factories were running here two hours after the shake, with no damage to repair. In a few hours after the earthquake Napa was starting three steamers loaded with supplies for the sufferers from fire in San Francisco.

Napa, Cal., May 23, 1906. Herbert H. Sawyer.

The San Francisco Earthquake Felt in China.

To the Editor of the Scientific American:

The great San Francisco earthquake has been registered by the seismograph of the Zi-ka-wei Observatory. The perturbation has been even rather strong, and the commotions propagated through the terrestrial crust lasted a little over 1 hour and 34 minutes. The pointer of the self-registering apparatus (ratio of multiplication = 15) has traced undulations of 66 millimeters. The first preliminary tremors, transmitted through the mass of the globe, began at 9 h. 31 m. 0 s. P. M., China coast time. The first big waves, coming on the crust, along an arc of great circle, were felt at 9 h. 11 m. 14 s. The last waves of decreasing amplitude left their trace at 10 h. 31 m. 31 s. P. M. and the last slight fluctuations of the ground died away at 11 h. 9 m. 44 s. P. M., April 18.

That phenomenon will help some day to calculate the velocity of propagation of the seismic undulations, when the exact minute and second of the occurrence at San Francisco is known. Meanwhile, adopting the means found from preceding quakes, by Prof. Dr. F. Omori, of Tokyo, for the transmission of the tremors on one hand, and of the superficial waves on the other, we find for the time of the disaster, the epicenter of which must not be far from the city of San Francisco, 5 h. 21m. on the 18th morning (Pacific zone time) by one method, and 5 h. 20 m. A. M. by the other, the figure being of course a mere approximation.

San Francisco has the official time of the Pacific zone, exactly 16 hours after the China coast (Shanghai) time. L. F.

Observatory of Zi-ka-wei, near Shanghai, China, April 18, 1906.

A Set of the Scientific Americans Wanted.

To the Editor of the Scientific American:

In the calamity of April 18 we lost everything—residence, church, and college. Our losses would approximate $800,000. Not least among them is our splendid library of some 35,000 volumes, which fire destroyed totally, and which some endeavor must now be made to restore. To that end we confidently seek some measure of your co-operation. While librarian of the St. Louis University in 1872, too many opportu-

nities were given me to judge how keenly alive our people are to the importance of your publication, not eagerly to covet, in their totality, the files of the Scientific American. They form a work of reference which St. Ignatius College can ill afford to be deprived of. We can hardly consent to be without it, and so become an exception among all our houses in the United States and Canada. On the other hand, our present financial plight makes payment quasi-impossible. Just now we have too many other financial problems pressing for a speedy solution. Ultimately, however, a favorable answer to our plea could hardly entail any loss on your part.

J. A. Frieden, S. J., Super. Miss. Col.

St. Ignatius College Library, San Francisco, Cal., May 25, 1906.

[Unfortunately, the publishers have no sets of the Scientific American that they could furnish the college library above mentioned, or they would gladly do so. The earlier issues of the paper are out of print. It is possible, however, that some of our readers may have, or may know of, sets, even if they are not entirely complete, that they would be glad to donate to the above institution, which has been such a heavy sufferer from the earthquake.—Ed.]

Fire-Resisting Qualities of Redwood.

To the Editor of the Scientific American:

I have always read your valued publication with great credence, but your correspondent in issue of May 12 at San Francisco, describing the conflagration after the great earthquake, seems to place great stress upon the very inflammable character of redwood as a building material and speaks slurringly of its virtues. He seems to be unaware of the fact that at no time was there more than an average of 30 per cent of redwood used in building construction in San Francisco, and for the past several years less than 20 per cent of the construction timber has been redwood.

Redwood contains no resin or turpentine of any kind, and, owing to its great resistant qualities of severe climatic conditions, is free from cracking or decay, where cinders might lodge and start fires. When burning it is easily extinguished with a small quantity of water and has the appearance of burned cork and is harder to ignite a second time than at first. When the famous Baldwin Hotel of San Francisco was burned five or six years ago, in the most densely populated part of the city, the firemen confined the flames to the building only; and while the heat in the interior of the building was sufficient to melt cast iron, the weather boarding (which was of redwood), by applying the hose to the outside walls, remained almost intact when the fire had been extinguished within after it had burned fiercely for five hours.

Redwood forests are practically unharmed by forest fires, and it is common practice for the lumbermen to fell the trees and peel the bark from them and, when the dry season is on, set fire to the felled timber and burn the branches and bark and other wreckage without practical injury to the saw logs, which procedure would mean disaster to any other wood. Owing to the cheapness of lumber and the great cost of other building materials at San Francisco it must necessarily be mostly reconstructed of wood. Where wooden buildings are well constructed on balloon frames, they are equal to A1 steel construction in resisting earthquake shocks; and if the city should be quartered by some wide avenues with auxiliary fireproof pumping stations connected with some of the power plants near the bay shore in each quarter, and three or four auxiliary reservoirs on high points in the interior of the city in case of a repetition of the past circumstance, fires could be easily confined to small areas, as it is considered by many that the fire could have been confined to the district south of Market Street if any water could have been had to keep it from crossing that broad thoroughfare.

The Southern Pacific Railroad Company saved their depot and yards south of Townsend Street with their own employes and private fire-fighting facilities, thereby saving the great lumber yard district along both sides of Channel Street.

If you would care to test the relative merits of redwood as a fire resistant, will furnish you samples of wood, as it is a very interesting subject to the whole Pacific Coast at present.

F. A. McKee.

Thorn, Cal., May 19, 1906.

Flying Machines and Wind Resistance.

To the Editor of the Scientific American:

As I am following the sport of gas ballooning, and have made ascensions of more or less importance myself (holding the American record for an endurance flight) I wish to correct a statement which is always to be seen with an article upon aerial navigation—that of "wind resistance." Often I hear (or read) of the resistance offered by the wind to an airship, aeroplane, or bird, and even a balloon, when in fact *there is no wind* to a body poised in the air. Wind (or air-currents) is a relative movement and is observed only when a body is resisting it. If an airship pitches more when running to the wind than when running away from it, it must be because of the fact (do not know the authority) that the wind is in waves, still this should be felt just as well when going with the wind.

An aeroplane cannot get help from the wind as is often stated, as it has only its own speed ahead to create it, and will get the same whether going with or away from the point of the wind.

A bird, aeroplane, or airship (so called) may and can go in any direction at equal speed in relation to the air in which it rests, but would not be able, of course, to do so in relation to the ground. A bird is able to fly to the wind and gain even in a high wind, simply because he has speed enough to fly faster than the current is moving away from his point of alighting. He will meet the same resistance if he flies with the same speed in the opposite direction. So, of course, with an aeroplane or dirigible balloon.

Mr. Walter Wellman states that he does not care for speed in his new airship. Speed is all that makes an airship. On a lake (or in still air) two boats would arrive at a given point even if one could make twenty miles an hour and the other but four miles an hour. But with the airship the ground advantage gained would be the difference between the speed of the ship through the air and the movement of the air in relation to the ground (assuming, of course, the ship is moving against this current) and would find the slow airship going backward much of the time, in relation to the ground.

The ship would make its speed in any event and meet no more resistance of the air than if it turned and moved with it, the ground speed being all the change it would undergo and that having nothing to do with the resistance offered to its progress through the air.

George T. Tomlinson.

Syracuse, N. Y., April 10, 1906.

A Miner's Theory of Earthquakes.

To the Editor of the Scientific American:

I have read very attentively the article in your issue of April 28 regarding the late disastrous earthquake here in California, and the views of scientists as to the causes thereof, the consensus of opinion attributing it to the slipping or breaking of the strata due to the strain caused by the shrinking of the earth's crust. In a local newspaper the other day Prof. Buckhalter, of the Chabot Observatory in Oakland, expressed his belief that it was owing to the settling of the adjacent Coast Range of mountains.

Now I am not what is called a scientist, but for forty years I have been a miner in earthquake as well as in other countries and—of course in a small way—am familiar with rock movements. While I think that the foregoing ideas are correct as to the initiative force, I am satisfied from my own experience that they do not go far enough.

I cannot conceive how the breaking or slipping of the strata for a short distance or even the settling of a mountain range—otherwise than indirectly—could have occasioned the continuous eccentric movement of the earth's surface which was witnessed here. Therefore I venture to suggest another explanation of the destructive motion in the wake of the settling or slipping of the crust as follows: I use crust in the common as well as the geological sense as a word signifying a hard substance superincumbent over a vacancy or resting on softer matter beneath. The geologists sometimes term it the sensitive crust.

Judging from the quantity of matter ejected from volcanoes in our own times, besides the enormous masses of lava lying in many places on the superficies of the earth, not the least of which are to be found here in California, we may surely infer that there are very extensive hollow spaces below the surface. The contraction toward the center of the globe would also have a tendency to originate them.

With what are these cavities filled? "Nature abhors a vacuum." The answer might be either air or gas, or a mixture of both, elastic and highly compressed by the attraction of gravity. Must it not have been a whiff of this gas, expanded and fired in its escape through the volcano Pelee, which destroyed St. Pierre, in a moment snuffing out thirty thousand lives?

As the jar from a heavy blast in a mine often throws down portions of the roof, particularly where the veins have but a slight inclination from the horizontal, so it seems feasible that shifting, settling, or breaking of the strata of the crust of the earth would cause a vibration which would dislodge and throw down parts of the overhanging roof of the cavities. The concussion produced by the precipitation of countless billions of tons, of incalculable masses of solid rock, into the gaseous medium to unknown depths below would assuredly cause it to impinge on the unstable vaultlike roof, the sensitive crust on which we dwell. No other hypothesis would as fully account for the undulatory, wavelike motions on the surface, which besides opening seams do the greatest damage, and gradually dying away as the distance from the fall increased, like the effect of dropping a pebble into a pond. The impact of these waves on the more solid boundaries of the cavern, the ribs of the globe, would transmit the shock through the seismic zone which encircles our planet. If instead of a gaseous body the roof is superincumbent on molten or liquid matter or any plastic material, the result would be the same. What is termed a twin earthquake would come from two great masses falling at short intervals. The subsequent minor shocks—which almost invariably succeed the greater—would ensue from the falling of smaller bodies jarred and loosened by the first heavy fall.

In a mine, after a cave of what was supposed to be solid rock or stable roof, the skillful, experienced miner is very careful, if work is being carried on in the vicinity, to examine it, look for and throw down parts which he expects have been left and are all but ready to drop. As it always happens that solid rock is broken in falling, it is calculated to take up fifty per cent more space than before. Hence the falling rock itself finally makes a new support for the roof. This would take place as the result of an earthquake in the way I have set forth, until the base from whatever cause became unstable. Unless the excavations in a mine are very extensive and very near the surface, it never caves to the top, even when abandoned. I have witnessed old mines pumped out which began to cave below as soon as they were free from the water pressure which sustained them.

In my own time I have had several experiences of air concussion. One in particular I have reason to remember well. The walls of a nearly vertical vein gave way from the jar of a heavy blast of dynamite, setting free the timbers supporting some hundred tons of waste rock, which fell about forty feet through an empty stope to the drive on which I was standing. So great was the rush of air, that I was only saved from being blown into the shaft by the cage being at the landing. A Cornish miner who was on the other side of the fall was knocked down and had his shirt torn off. Prof. Buckhalter in the article above mentioned is quoted as saying that there was no preliminary shock. I certainly noticed one, and I know my earthquakes. I was awake in bed when the tremor commenced in the southeast corner of the room which I occupied on the upper—the second—story. I had plenty of time to think, to put it in words—"Hello! this is a temblor"—before the big shock came. Our house is a small wooden building, a mere box, and although I felt in the big shock as if a dog had it in his mouth and was shaking it, growling horribly the while, beyond the fall of the top of the chimney it sustained no damage whatever. Our next-door neighbor was not so fortunate. His house—only one story—was higher above the ground, supported by slender timbers, mere stilts, fell over and leaned against ours. The preliminary tremor which I observed I would call the shifting, settling, or breaking of the strata, the great shock the fall of a mighty mass as set forth above. To return again to the mine for a comparison, the watchful workman is often warned by a slight noise and dropping that a heavy fall is impending, and is thus given time, but not always, to jump to a spot which he has foreseen is secure.

Would not the foregoing theory account for the tremendous earthquake and tidal wave which followed the blowing up or explosion of Krakatoa in 1883, brought about, it is supposed, by the irruption of water into that volcano? Also for the behavior of Ihalco, a volcano near Acajutla on the coast of Salvador, which I have often watched? Every forty minutes or so it throws out red-hot stones and lava, supposedly from the slow infiltration and accumulation of gas from the adjacent home of the volcanoes and earthquakes. San Salvador, the capital close by, is nicknamed the swinging or rocking hammock from the frequent earthquakes there.

In connection with the foregoing there is one thing which I am free to acknowledge I do not understand, and cannot fully account for. For nearly three years I mined in Honduras within as many miles of the frontier. Fifteen miles away in Salvador rises a volcano called San Miguel. Sometimes it smoked without eruption; again it was quiet. It was always the predominating feature in the landscape, seemingly so close that I always considered, so to speak, that it was in my front yard. There were frequent slight earthquake tremors, but they were always imperceptible in the mine. I think it was in 1889 that I was employed in El Callao Mine in the Guiana of Venezuela, east of British Guiana on the Yuruari River, between the Orinoco and the Amazon. There we had an earthquake, which although not very severe lasted fully three minutes, and as we afterward learned was felt all over the West Indies. I was on the surface, and our first thought was what had happened in the mine, where there were great open spaces and upward of two hundred men at work. On going down we found that the trembling had passed unnoticed below.

E. D. Guilbert.

274 West Santa Clara Street, San José, Cal.

MECHANICAL COMPRESSION OF THE GROUND IN THE CONSTRUCTION OF FOUNDATIONS.

BY EMILE GUARINI.

M. Ducloux, directing engineer of the Société des Fondations par Compressions Mecaniques du Sol, recently delivered before the Société Belge d'Ingenieurs et Industriels a very interesting lecture upon the foundation method employed by the Société, and which consists in compressing the ground by treating it with concrete in such a way as to compress it laterally and depthwise.

In matters of construction, the question of foundations is one of the most important and difficult, and, in most cases, becomes the subject of numerous studies. The entire stability of an edifice, in fact, depends upon the adaptation of its foundation to the ground upon which the building is to rest. So it is necessary to examine the nature of the ground by boring, to ascertain the thickness of the strata and calculate their resistance, and to render wet ground firm by drainage, etc.

It is principally when it is a question of loose argillaceous, sandy, wet, or filled-in ground that the matter becomes complicated and puts the experience and sagacity of the engineer to the test. It becomes necessary for him to select from among previously employed methods the one best adapted to the particular case in hand; and such a selection is always difficult, even when it is not hazardous.

The cases that may arise are very numerous, and the solutions of the questions that are capable of intervening are manifold. For the consolidation of loose soil, various processes have been recommended. We shall not recall the methods to which recourse has been had up to the present, since they are well known and may be found described in all technical works, but shall confine ourselves to the one that formed the subject of M. Ducloux's lecture and which is based upon the Dulac process, the conception of which is more recent.

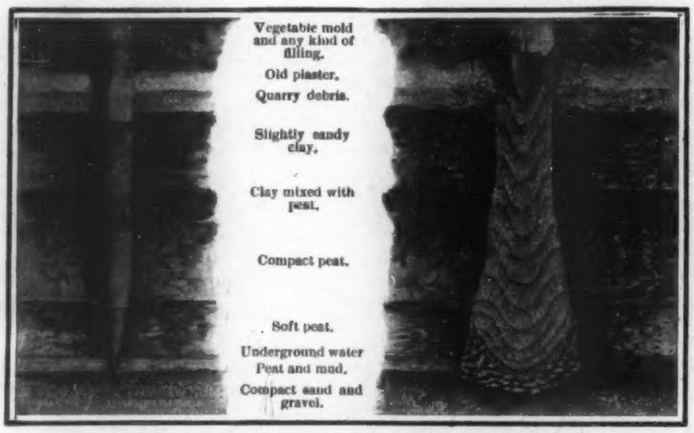
An endeavor has for a long time been made to consolidate unstable ground by the use of piles. The piles, which are of wood and set very close together, compress the earth laterally, and increase its stability through the resistance that they impart to it. The idea has occurred also, and has sometimes been put in practice, to substitute for such consolidation by wooden piles a reinforcement by masses of sand or concrete. The ground is prepared by sinking piles and then withdrawing the piles so as to leave cylindrical holes which are afterward filled in with concrete in order to maintain the compression.

The Dulac process offers some analogy to this method, and may be considered as an improvement upon the rudimentary one. It is more complete in its action, and is designed to form in the ground, whatever be its composition, rigid bearing points resting through a base of adequate width either upon the natural soil or upon earth that has been rendered properly resistant by mechanical treatment, such as ramming. Girders or beams are secured to the bearing points, which thus become rigidly connected, so that the whole constitutes an indeformable mass.

The apparatus employed are relatively simple and not very numerous. They consist of a pile-driver, say 40 feet in height, and three rams of appropriate form and size with automatic nippers.

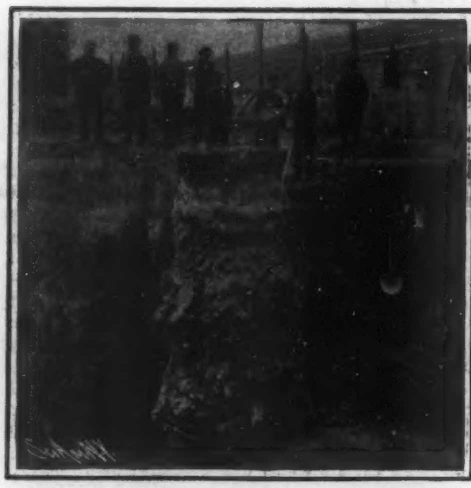
The pile drivers are actuated by a steam windlass. Some are rotary and mounted upon two superposed tables with a circular base, while others are mounted upon platforms with a rectangular base. The type employed depends upon circumstances. The first are particularly well adapted for work at the bottom of an excavation. The automatic snaffles form a special apparatus which is supported by a chain carrying pulley blocks, and the operation of which presents no complication.

One of the rams is placed upon the pile driver. The snaffle grasps its rod, which terminates in a top-shaped head. When the engine is in motion, the chain winds around the windlass and the snaffles ascend and carry along the ram. At a certain point of the cheeks there is a ring the height of which is regulated at will. This ring has the form of a double funnel. When the upper part of the snaffles, which grasp the head of the ram so much the more firmly in proportion as the latter is heavier, reaches the ring in question, the lower part opens and allows the ram to escape and drop. The snaffle then descends by its own weight and grasps the ram again and lifts it anew to the ring. As we have already said, three kinds of rams are used in the process. The first, of ogival form, has a base of 24 inches in diameter. It is placed point downward, and falls in this manner. Its weight is 3,300 pounds. Another and heavier ram is of conical form and called the perforator. It has a base of 28 inches and weighs 3,520 pounds. Its drop is about 40 feet.



The Ground is First Bored; the Boring Filled With Clay, Which is Rammed Down.

It is either solid or hollow. When solid, it presents at its lower part a small cavity in which is stored a quantity of the earth with which it comes into contact. When hollow, it is designed to render the work easier when the operation is performed in incompressible and wet earth. It is then composed of a truncated cone which is in two parts that are assembled in the direction of a diametric plane, and that are capable of pivoting around an axis of assemblage. It operates after the manner of a punch, which cuts a mass of earth out of the ground. It is provided with a notch that serves for opening it. For this purpose, a catch that holds the two pieces is unfastened, and a wedge is introduced into the notch. The two constituent parts of the wedge pivot upon each other and disengage the earth.



Compressed Earth Pile Dug Out for Examination.

The third, or test ram, is designed for testing the resistance of the ground, either before or after the operation. It has the form of a truncated cone and falls with its wide base (of 32 inches diameter) downward. Its weight is 2,200 pounds. The measurement of the resistance is effected very simply, the latter, in fact, being inversely proportional to the mean depth attained by three or four blows of the ram.

In practice, it is generally granted that half the work produced by the fall is expended in vibrations, etc., while the other half is utilized and capable of serving as a basis for the estimation of the resistance by square inches. This, the height of fall of the ram being given, is simply deduced from the weight of the ram and the surface of the base.

Calculations show that penetrations of 40 inches and 4 inches correspond respectively with resistances of 15.6 and 13.2 pounds to the square inch.

The method of work varies according as the ground is accessible to the laborers and the machines, or as to whether it is constantly covered with water. If, for example, it is desired merely to consolidate filled-in ground with a view to the construction of a building of considerable weight, the earth is submitted to the action of the ram after the excavations, for the walls have been affected.

Holes from 40 to 60 inches in depth are thus formed in the ground. These are filled about a third full with hard material, which is rammed down, and then a new charge is introduced and rammed down, and so on. The ground, strongly compressed, takes on a consistency which rapidly increases and which may be rendered uniform. The operation is not nearly so simple when it is performed in wet earth, and particularly in earth constantly covered with water.

In wet soil an excavation is made that gives a well of which the sides, compressed by the ram, have sufficient tightness. If seepage of water occurs, clay is introduced into the hole and the operation is begun again.

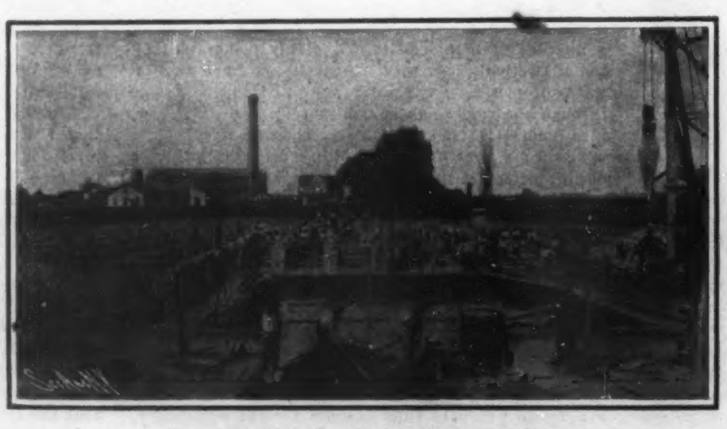
It is easy to obtain a well of temporary permeability that may be filled with large stones. These may be driven laterally by the ogival ram, and then a new charge be introduced and rammed down, and so on, until there has been established a sort of inverted "mushroom" produced by the lateral expansion of the materials thrown into the well. The filling in is completed with materials of proper resistance firmly compressed.

Finally, if the ground is still more watery, the process employed is as follows, the same apparatus being used: A light *batardeau* is established around the site reserved for the foundation that it is proposed to construct; and in this way is formed an inclosure which is filled in with vegetable mold or ordinary earth, which expels the water to such an extent that there is obtained a sort of platform upon which the different apparatus may be installed. Then the ramming of the ground is begun. By means of the perforating ram a well is formed into which is emptied one or two wheelbarrowfuls of argillaceous earth. The blows of the ram drive the earth laterally in a stratum which is reinforced by new charges, and there is thus formed an argillaceous casing of from ½ an inch to 1½ inch in thickness.

The operation of perforation should be conducted slowly in order to obtain a proper subsidence of the earth. The thickness of the internal tight coating should be proportionate to the pressure of the water, which latter increases in measure as a greater depth is reached. It is well, therefore, that the work of ramming be pushed and the quantity of clay introduced be increased.

This part of the work is effected first by means of the perforating ram, and then by the tamping one when hardpan is approached. It widens the mouth of the hole made by the perforator and prepares the base that it is desired to obtain. The concrete introduced is designed to prevent the water from rising through pressure from beneath, and it must therefore be used in adequate quantity. Angular materials also are introduced and submitted to a vigorous ramming. These materials, owing to the concrete that is poured in in order to fill the interstices, and to the ramming to which they are submitted, constitute a perfect masonry.

Finally, in all cases, masonry pillars are formed that have a wide bearing surface upon the ground, and the diameter of which is proportionate to the hardness of the ramming. These pillars transfer directly to the ground the pressure that the structure exerts upon them. These operations are repeated as many times as need be, in order to obtain a succession of strong pillars that have the same form as if they were built on ground that was quite accessible. The materials introduced into the ground are always strongly compressed.



Rammed Earth Foundations for a Building.

MECHANICAL COMPRESSION OF THE GROUND IN THE CONSTRUCTION OF FOUNDATIONS.

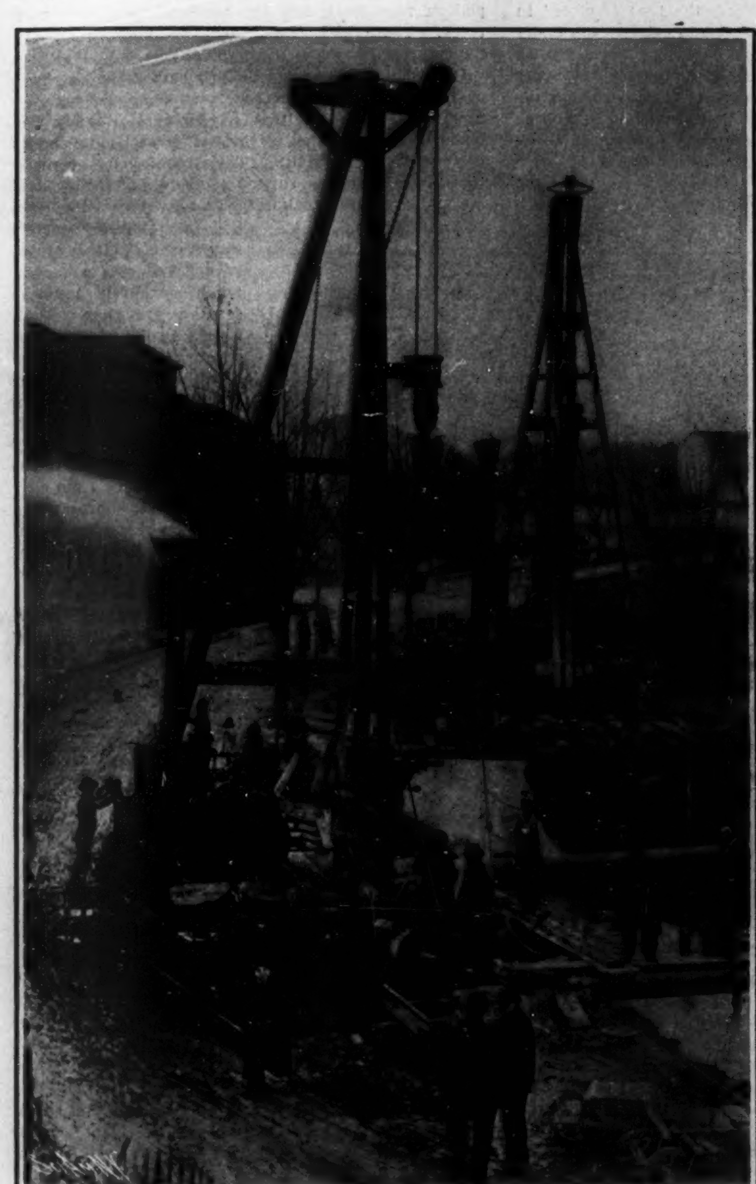
It is possible to dispense with the coffer dam by substituting for the protective lining of clay a cylinder of concrete, reinforced or not. The cylinder may be introduced into the bed of a river so as to emerge from the water, and the water that it contains be exhausted by pumps placed upon a pontoon. Then, after the well has been sunk, it may be filled in as above described, and the concrete cylinder afterward be filled.

It is scarcely necessary to bring into prominence in this place the difference between this method and the processes in which there is no ramming, but merely a pouring of concrete into the well, the sides of which are wanting in stability. On the contrary, the Dulac method affords wells that have strong walls, which are rendered still more compact by the subsidence of the concrete, the quantity of which sometimes exceeds a quintuple of the capacity of the hole. The diameter of the latter is increased, and, from 36 inches at the outset, passes to 40, 44, 48 inches and beyond.

The bearing points should be distributed as uniformly as possible, and their distance apart should vary according to the load that they have to support. As has already been stated, they are generally connected in such a way as to form a more compact and rigid distribution affording greater safety.

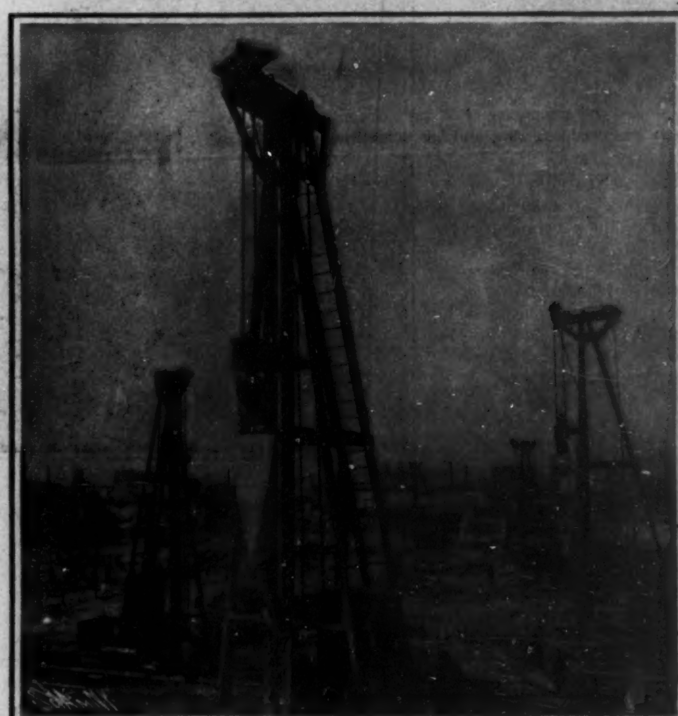
Upon the whole, the method substitutes for the excavation of wells by manual labor, a more rapid and surer boring that safeguards the laborers against inundations of the bottom of the well, cavings in, etc., and does away with boarding up, pumping and other analogous operations. It affords a greater resistance for the reason that the contact of the concrete of the pillar with the sides of the hole is always perfectly assured.

In addition to such arrangements, reinforcements of iron are almost always introduced into the mass of the pillars in order to effect a subsequent connection of the latter. Such reinforcements are arranged circumferentially so as to permit of the passage of the rams and especially of the tamping one, which compresses the materials. The iron reinforcing rods serve not only for connecting the pillars with each other, but also for forming a sort of monolith with the structure properly so called, when it is of protected concrete.



Ram for Testing the Resistance of the Ground.

Laying a Reinforced Concrete Floor on an Earth Foundation.



One of the Perforating Rams at Work.

MECHANICAL COMPRESSION OF THE GROUND IN THE CONSTRUCTION OF FOUNDATIONS.

Practical Tests of a Model Fireproof Theater.

Some highly interesting tests were recently conducted by the Austrian Association of Engineers and Architects in order to find out the best methods of fireproofing theaters. An iron and concrete theater was especially built with this object in view, embodying all the improvements so far suggested for the purpose, and in this a series of rather conclusive tests was carried out in the presence of experts and representatives of both German and Austrian authorities. In order to examine the phenomena occurring during the fire, a compartment two meters in width had been separated from the auditorium by a well, provided at the top with glass-covered openings.

In the first test the ventilation device above the stage was closed, while that of the auditorium was kept half open, the woven curtain being lowered. After the stage had been set on fire, the woven curtain was seen to bulge out toward the auditorium, and a violent flame projected from underneath the bulge, rapidly filling the auditorium with smoke and deleterious gases. The gas flames first went out as a consequence of the pressure of the hot gases, and the candles, oil, and petroleum lamps subsequently followed their example, owing to the lack of atmospheric oxygen. The electrical lamps, which were likewise provided, were so enveloped with smoke as to become invisible. In the air, filled with carbonic acid gases, pressures up to 160 millimeters water column and temperatures of up to 400 deg. C. were observed, and under these conditions human life would have been destroyed within a few seconds.

In another test the general arrangement was the same as above, with the exception of keeping the stage open until closed by the iron curtain during the fire. The phenomena observed were about the same as in the former case, and even more dangerous to spectators, as the tongues of flame penetrated into the orchestra space.

A third test was then made with the ventilation devices above the stage opened, after the stage had been set on fire, while those of the auditorium were kept closed and the curtains opened. The fire developed as in a large chimney, the smoke gases escaping through the open pit and aperture in the roof, while the auditorium being free from smoke and noxious gases, did not present any danger to the spectators. During this trial the lights were not extinguished. In connection with a fourth test the ventilation outfit above the stage was not opened until after the fire had developed, that above the auditorium being kept closed. In this case the spectators would have been in no way endangered, and the illumination continued to work satisfactorily.

A fifth test was finally made to try the efficiency of the sprinkling apparatus, the stage and the ventilation apparatus above the same being open and the ventilator above the auditorium closed. After the sprinkling apparatus had been turned on a lively spray was poured out of the stage, considerably damping the fire, the steam and smoke escaping through the ventilation apertures in the stage. All open doors proved rather dangerous, owing to the hot draft produced, which carried the smoke, steam, and burning pieces of material into the auditorium. The water spray, however, efficiently eliminated any danger. The above tests have aroused a great amount of interest in continental engineering circles, and will doubtless lead to a more efficient fireproofing of theaters.

Since February 14 the regular passenger traffic with Siberia has been restored as it existed prior to the war, and goods of all categories are now carried without any obstruction as far as the station of Atchinsk, which is 409 versts east of Tomsk. Nevertheless, it would seem that the line to the East is in a bad state of repair, for the Russian Treasury propose to issue in the course of the present year a loan of twelve million rubles for the Chinese Eastern Railway, which is the Manchurian line.

THE SNAG BOATS OF THE SOUTH.

BY DAY ALLEN WILLEY.

One of the greatest obstacles to navigating the streams of the South and Southwest are the snags. Watercourses like the Mississippi and its tributaries which are subject to extreme changes in depth during the year, and which pass through the dense forests of the West and Southwest, contain so many snags that one of the most important duties of the government engineers in charge of these streams consists of keeping the waterway free from such obstructions. While there are several different methods of removing snags, "snag boats" have recently been designed which are especially adapted for freeing the channels of obstacles to navigation, and are equipped with labor-saving appliances of no little interest.

The inundations of the woodland adjacent to the Mississippi and its tributaries, are at times so great that trees of the largest size are washed out of the formation. They naturally drift toward the center of the watercourse, where the current is strongest, and may be carried hundreds of miles before finding a resting place on some shoal or before they are deposited by the lowering of the water. At times they remain submerged for such a period that they become water-logged. As some of the trees are four and five feet in diameter above the root mass, powerful mechanism is required to remove and destroy them. The force of the flood current in such rivers as the Mississippi, the Red, the Arkansas, and the Missouri is so great that snags ranging thirty to fifty feet in length and having a mass of roots actually twenty feet in diameter, have been lodged in the center of the river bed, the lower end being driven deep into the sand and mud with such force that it has been necessary to employ divers to dislodge it before it could be pulled out. As the trunk or log is often carried down stream in an oblique position, many of the snags are driven into the bottom pointing upstream at such an angle that they form a menace to the lightly built steamers and barges which ply upon these inland waterways.

One of the most powerful types of snag boats used by the government is the "Macomb," which is illustrated by the accompanying photographs. The "Macomb" is employed in the St. Louis district under the supervision of Major Thomas L. Casey, of the corps of engineers, and performs such valuable service in keeping the channels in this district free from obstruction that it is really indispensable to river commerce. The boat is constructed with a hull of iron and steel, 178 feet in length, 62 feet beam, not counting the paddle boxes, with 8 feet depth of hold. Despite its displacement of 1,100 tons it draws less than four feet of water, and consequently can be operated on shoals and in other shallow spots. Two non-condensing engines of a combined capacity of 600 horse-power furnish motive power, giving a speed ranging between five miles and six miles an hour upstream against a strong current.

The interesting features of the boat, as will be noted by the illustrations, are the double or twin bows. These are separated by what is termed a well which is 12 feet in width, each bow being 65 feet in length. At the forward end what is termed a "butting beam" extends from bow to bow. This is a heavy steel beam 22 feet in length, 7 feet wide, and no less than 16 inches thick, greatly strengthening the framework of the boat. As the name implies it is used to ram or butt a snag when necessary to dislodge it from the bottom before pulling it out of the water. Attached to this beam, however, is a sweep chain which drags beneath the water and is designed to grip the lower portion of the snag and aid in lifting it to the surface. This chain is lowered over the bows by a capstan placed at one end, and raised in the same manner. Its purpose is principally to lift the upper end of the snag high enough to push the butting beam under it.

Installed upon the bows are three shear legs, one being utilized to pull out small snags after they have been loosened by the sweep chain and butting beam. Those on the sides are intended to pull up obstructions which can be readily removed by means of block and tackle. The center shear legs are by far the largest. The lower end of the tackle they support, consisting of a heavy chain, is looped around the snag to be handled. The most powerful appliance employed is the so-called Sampson chain. This is composed of 2¼-inch links and winds in and out on a cast-iron drum which is mounted on the forward end of the boat. The chain is used for direct pulling after the snag has been sufficiently dislodged to raise it to the surface, and has a breaking strength of no less than 75 tons. Some of the obstructions, however, are of such a size that this chain has actually been broken in attempting to remove them.

The power for operating the various hoisting appliances and for pulling the snag upon the beam consists of four steam capstans each having a direct pull of 35 tons and a maximum speed of 30 feet per minute. Including the purchase which actuates the Sampson chain, the combined tractive force exerted is 215 tons, while the butting force when ramming the snag is no less than 800 tons.

When a snag is located of such a size that the chain and center shears are required, the boat is placed in such a position that the sweep chain engages the under side of the obstruction. The capstan connected with this chain is then started, and as it tightens, the upper end of the snag is lifted above the surface so that the Sampson chain can be made fast around it as well as the chains connected with the center shears. If necessary the snag boat is driven ahead at full speed, butting the tree with its heavy steel beam while at the same time the capstans and purchase exert their combined lifting power. As soon as the snag is dislodged the propelling engines are stopped and the obstruction lifted upon the butting beam. Here it is lowered upon a roller and cut into logs by steam crosscut saws working horizontally, the portions cut off dropping into the well and floating away. This part of the work is easily accomplished, but as it is impossible to separate the root into sections this is generally held between the bows, carried to some deep spot in the channel, and deposited where it can form no obstruction. As the photographs show, each saw is guided by one man, being attached to metal bars which in turn are connected with axles designed on the eccentric principle, which gives them the necessary forward and backward motion.

As already stated the "Macomb" includes divers in its crew of forty officers and men. At times the snag is of such dimensions and so firmly imbedded that it is utterly impossible even with the powerful equipment to remove it. Then dynamite is placed in holes in the trunk and it is blown out of its position. The boat is also equipped with powerful hydraulic pumps for washing out the mass of mud, gravel, and other detritus which frequently accumulates on snag roots, greatly increasing the weight. At times the lower part of the snag may be so covered with this material that it cannot be sawed into pieces until thus cleansed.

Another large snag boat in use on the Mississippi and tributary waters is the "Charles R. Suter." This craft is 187 feet in length, 52 feet beam over the hull, and can operate in water 3½ feet in depth. It is also constructed with a hull of steel and iron and driven by two oscillating engines, steam being furnished by five 42-inch boilers giving it a total horse-power of about 500. The snagging apparatus consists of two pairs of friction capstans placed in the forward hold and six Providence capstans installed on the deck. The Suter carries a butting beam of oak plated with iron, also a series of five iron shear legs in addition to supporting blocks and tackle, a Sampson chain of 2½-inch links, and a sweep chain.

Sawing Off the Roots So That They Cannot Secure a Hold On the Bottom.

THE SNAG BOATS OF THE SOUTH.

POWER TRANSMISSION LINE OF THE LONG ISLAND RAILROAD.

In our issue of April 28, 1906, we published a description of the new Long Island City power station, which was built to supply power to the Pennsylvania tunnel under the East River and to the Long Island Railroad system. A portion of this power has already been put to use on the suburban lines of the Long Island Railway, and we have just received a detailed description of the electrification of this system. The system is supplied with six sub-stations and two portable substations, the latter to be used for supplying current for the heavy periodic traffic to and from the Metropolitan race track and the new Belmont Park race track. These loads occur for two hours each day for a period of two weeks, twice a year.

In reaching a decision as to whether the overhead or underground type of construction should be used for the transmission lines, a very careful study was made of the operation of lines of great length and of large carrying capacity. The troubles in overhead lines were found to be due to wind, lightning, sleet storms, structural weaknesses of poles, crossarms, pins, and insulators, or outside interferences either from branches of trees or thieves, and very rarely by heat from a fire close to the route. In the underground construction, on the other hand, it was found that breakdowns were generally due either to capacity effects causing extraordinary voltages, or to depreciation of cable sheaths from electrolysis, or to short circuits by reason of mechanical injury, imperfect insulation, and occasionally to overloading or gas explosions in manholes. A comparison of the causes and effects of the troubles in these two classes of construction led to the conclusion that although overhead lines are liable to more frequent interruption through minor troubles than underground lines, yet the interferences with continuous operation on an underground line, when they do happen, are likely to be of a far more serious character and of longer duration. Overhead construction was, therefore, adopted wherever it was usable. Owing to the topography of the system, the sub-station at Woodhaven Junction became a natural distributing center between the power house and the other sub-stations, and for this reason a main power-transmission trunk line was led directly to this point, to distribute the entire output of the power station among the different substations. The impracticability of constructing high-tension overhead lines in thickly populated sections of Brooklyn and Queens required the construction of conduits in two sections of the line, one running from the power station to Dutchkills Street, and the other between the Flatbush terminal and Dunton, just west of Jamaica. Except where submarine cables were used at the Broad Channel and Beach Channel drawbridges in the Jamaica Bay trestle, the remainder of the transmission line is of the overhead type of construction.

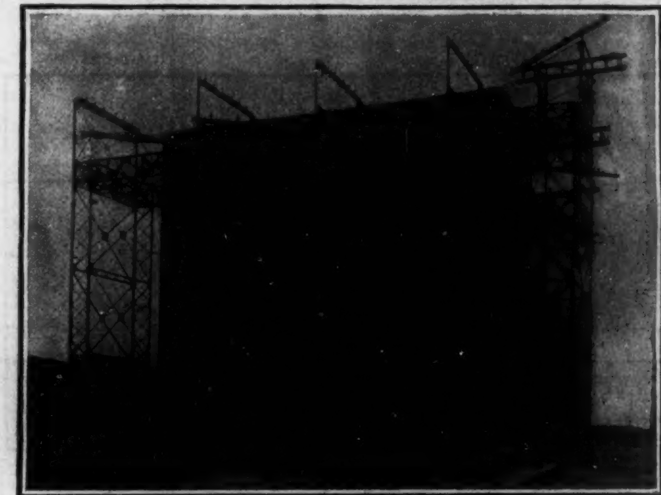
Much of the underground construction leading from the power station to Dutchkills Street involved serious complications, owing to the fact that it is situated below the level of the ground water, so that special provision for drainage was necessary. The manholes in this part of the line are connected by a line of 8 inch sewer pipe laid beneath the ducts and entering the manholes about 18 inches from the bottom, thus forming catch basins to prevent silt or other foreign matter from getting into and clogging the pipe. The line is so pitched as to bring all the drainage into three sumps, which are kept pumped out by electrically-driven, submerged, centrifugal pumps, automatically controlled and discharging into the city sewer system. During the construction of this conduit line it was necessary to line the trench with 3-inch tongued and grooved sheathing, and to use the sump pumps con-

tinuously to remove water. The line is constructed of single vitrified clay ducts, which were used in preference to multiple ducts because of the thicker walls between them. Manholes for drawing in and splicing the cables were located 400 feet apart on straight work, and at shorter distances on curves. On the Atlantic Avenue line four-way vitrified clay ducts were used.

The underground high-tension cables are of the three-conductor type, each conductor having a cross section of 250,000 circular mils and being composed of 37 copper wires. The cables were tested at the factory by applying 30,000 volts between each pair of conductors and between each conductor and the sheath. At the drawbridge in the Jamaica Bay trestle the cables are of the armored submarine type, the insulation being composed of 30 per cent pure Para rubber covered with a sheathing of lead and tin. Over this is an armor of galvanized-iron wires laid spirally on the outside of the lead covering, with a layer of jute between the lead and the armor. The cables were laid across the channels and allowed to settle to the bottom, after which they were properly separated by a diver, and were then sunk into the mud by means of a water jet to a depth of 4 feet below the bottom of the channel. There are in all about 25 miles of high-tension ground cable installed besides 0.418 mile of armored submarine cable.

The vulnerability of underground cables to lightning and to other static disturbances which may be set up in the transmission line required that the outlying ends of transmission cables exposed to lightning charges be provided with protective apparatus. Wherever the underground cable section of the transmission line is joined with the overhead system, lightning arresters and choke coils are installed, suitable houses being provided to shelter this apparatus. One of these houses is located on the main transmission line at Dutchkills Street, and another at Dunton on the branch line running east of Woodhaven. Smaller houses are also provided for the same purpose at the two drawbridges. These houses are entirely fireproof. The incoming cables are carried through the floor by means of ducts reaching to the last manhole in the conduit line, and are arranged along the wall running through switches and through the choke coils to the various outlets along the various portions of the outside walls. The arresters are mounted on either side of the steel framework in the center of the building, and the ground connections all run to a single ground lead, consisting of 5½ square feet of copper plate buried between layers of crushed coke. The outgoing cables on each side are anchored on a strain pole after leaving the racks upon the sides of the building, which, in themselves, are not intended to carry the longitudinal stresses of the overhead cables. The protection afforded by this system seems to have been very effective, as, although a number of lightning discharges are known to have been taken by the arresters at various times and places, no damage is known to have resulted to the cables.

The overhead line construction is of a very substantial character. The trunk line is carried on steel poles which are designed to support twenty-four 250,000 circular mil cables on their upper portions, and underneath them an additional load of eight 500,000-circular mil low-tension cables, which local regulations require to be at least 25 feet above the ground. The steel poles are built of four corner angles, connected by angles and plates, forming a lattice type of construction. The poles are designed to withstand a wind pressure at right angles to the line corresponding to a wind velocity of 100 miles per hour. This was calculated from data obtained in the Berlin-Zossen high-speed railway tests, which showed the pressure on a flat surface due to a wind velocity of 100 miles per hour to be 27 pounds per square foot, which applies to the flat surfaces of poles and cross-arms. For the projected area of the cylindrical conductors one-half of this value, or 13½ pounds per square foot, was the factor used for the above-named velocity. An extra heavy pole, called a strain pole, is used for turning sharp corners, and for anchoring the line at special points. The ability of the steel pole to act as a lightning rod is turned to advantage. Each pole is thoroughly grounded to a copper plate buried beneath the foundation, and connected to one of the anchor bolts by a copper wire. The transmission cables were strung for the most part by means of teams of horses and running lines of 1,000 feet or more in length, the cable reels being mounted on stationary stands. On the trestle, however, this method could not be so readily followed, and the cables were strung in the following manner: The reel of wire was carried on a flat car, upon which was mounted a boom capable of being swung to one side to the position which would be occupied by the wires. At the end of this boom was a snatch block, through which the wire passed and by which it was guided onto the cross-arm. The car was moved along slowly by a locomotive, and wire paid out, and the boom was raised at each cross-arm, so that the wire would drop onto the arm. Wherever the power-transmission circuits cross the highways or railroad tracks, special precautions are taken to insure against the possibility of the cable falling off a cross-arm and hanging down in position to endanger passing traffic. At the Woodhaven and Rockaway junction sub-stations, special terminal poles or racks are provided to distribute the overhead circuits along the face of the building parallel to the high-tension switching galleries in such a manner that the disposition of the cables after entering the building will be most convenient. At Rockaway junction the location of the sub-station is such that the entering circuits coming from the west had to be taken to the east side of the building, and distributed from the rack there situated. The entering circuits are kept on the west side of the cable rack next the building, while the outgoing circuits which continue eastward are kept on the east side of the rack, thus preventing crosses and making it possible for either set of circuits to be repaired independently of the other set.



The Terminal Rack at Rockaway Junction.

Arrester House at Jamaica Bay Drawbridge.

Stringing a Transmission Cable at the Jamaica Bay Trestle.

POWER TRANSMISSION LINE OF THE LONG ISLAND RAILROAD.

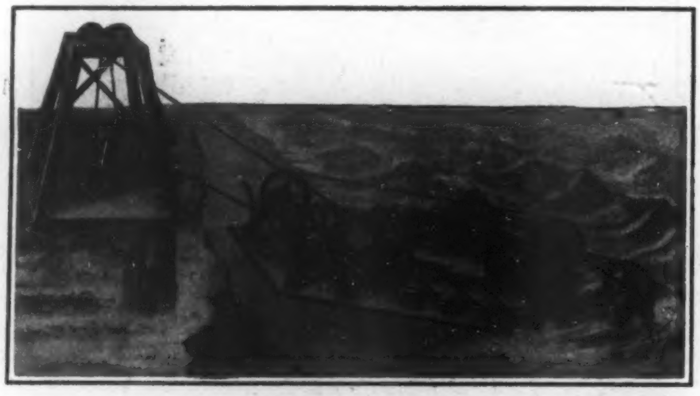
The use of concrete masonry probably begins with the Romans, who employed it in road building and foundation work. Coming down from the time of the Romans, the ancient city of Ciudad Rodrigo has walls existing at the present day in which are buried large bowlders of stone. These walls are in a good state of preservation at the present time; in fact, so much so that they still bear the prints of the boards which made up the forms which held the concrete in its semi-liquid state at the time it was put in. It is an interesting matter to note that the modern practice of putting large masses of stone in concrete masonry follows exactly the scheme used in building those ancient walls of Ciudad Rodrigo. This method not only reduces the cost of the resulting fabric, but also makes it stronger.

Typhoid fever deaths in New York State numbered 1,554 during 1905, according to the report of Dr. Eugene H. Porter, State Commissioner of Health. Dr. Porter says that it is no exaggeration to attribute almost every one of these deaths to infected water. While there may be some doubts as to this statement, unquestionably many of the deaths were so caused, and there is no doubt that his recommendations for a better sanitary control of the potable water of the State should be heeded. He recommends legislation "providing that all plans for public water supplies be approved by the State Commissioner of Health, and also to secure inspection of proposed and existing sewer systems and water supplies."

Patent Department

SURF ACTUATED MOTOR.

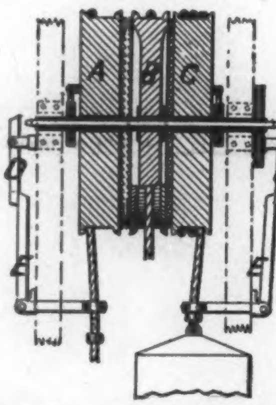
Pictured in the accompanying engraving is a motor designed to be actuated by the wash of surf. The apparatus comprises a platform, which is laid on a sloping beach with its lower end extending into the water. Standards at the corners of the platform support four sheaves, about which two cables are passed. These cables are secured to the pulley wheels of the motor proper, and are used to adjust the latter into or out of the water, as desired. This adjustment can be secured by turning the crank, which is indicated in the illustration. The motor proper comprises a chain or belt of buckets, which are carried by cables fastened over opposite pulley wheels. The buckets on the lower stretch of the belt are open and catch the water of the surf, which owing to its weight drags them down along the platform. To facilitate this movement the buckets are provided with rollers adapted to bear on the platform. As the buckets pass around to the upper stretch of the belt, they are inverted and emptied of water. A cable conveys the motion of the chain of buckets to a train of gearing mounted in a building or framework on the shore. The cable passes over a pulley at the top of this framework, thence about a pulley supporting a counterweight, and back to a second pulley at the top of the framework, whence it passes around a pulley marked *B* in the detail view. The counterweight serves to take up slack when the motor is drawn in toward shore. The pulley, *B*, is fixed to a shaft, and mounted on this shaft at either side of the pulley are two drums, *A* and *C*. The opposite faces of the pulleys and the adjacent faces of the drum are formed with clutch teeth. About each drum a cable is wound, which carries a weight at its free end. In the illustration, the drum, *C*, is shown in engagement with the clutch pulley, *B*, and is winding up its cable and lifting its weight. As soon as the weight reaches a predetermined position, a stop on the cable strikes the lever *E*, tilting it and causing it to swing the lever, *D*. The latter pushes the pulley shaft to the left, releasing the drum, *C*, and causing the clutch pulley *B* to engage the drum, *A*. Then, as the drum, *C*, unwinds its cable, the drum, *A*, lifts its weight until it in turn operates the pulley shaft to move the clutch pulley to the right. The weights here shown are used merely to illustrate the operation of the motor. It will be evident that the same power can be applied with advantage in other directions. The inventor of this motor is Mr. Tad Danford, 1241 Fourteenth Street, San Diego, Cal.



SURF-ACTUATED MOTOR.

A NOVEL REFLECTING LAMP GLOBE.

In the accompanying engraving we picture an improved reflector and globe for lamps. The device is equally applicable to kerosene, gas, and electric lamps, and our illustration depicts a combination fixture showing the globe as used both with electric and with a Welsbach light. The globe consists of a glass or porcelain body, preferably spherical in form, though other forms may also be used to suit artistic tastes. The surface of the sphere is provided with a series of cavities of substantially pyramidal form, arranged in horizontal and vertical rows. These cavities are formed on the outer side of the globe so as to produce pyramidal projections on the inner side, as indicated in Fig. 2. At the bottom of each cavity the inclined faces are connected by flat surfaces which may be called windows. The inclined faces are coated with a reflecting substance, such as mercury, while the bottom face is left translucent, or transparent, as the case may be. Thus the light of the lamp striking these silvered surfaces is reflected and passes out of the globe through one of the opposite windows. A very artistic and pleasing effect is thereby produced. A modification of this construction consists in inverting the cavities, that is, forming the cavities on the inner side with the windows projecting on the outer side. The inner inclined faces of each cavity are then silvered and serve to concentrate the light that falls on them, reflecting it all through the window. The globe then appears to be made up of a series of beams of light. Mr. Z. Matlowsky, of 47 Chester Street, Brooklyn, New York, has recently been granted a patent on this improved globe.



DETAILS OF SURF-ACTUATED MOTOR.

A NOVEL REFLECTING LAMP GLOBE.

Brief Notes Concerning Inventions.

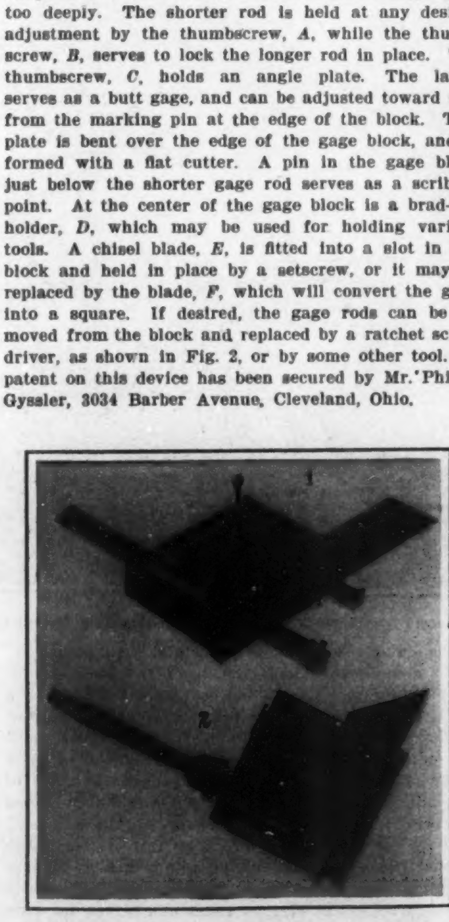
A motor designed to make a hammock self-swinging has been recently invented by Francis J. McDonnell, an employe of the custom house at New Bedford, Mass. This motor is operated by the weight of the person occupying the hammock or swing, to which it is also adaptable. It is of very compact form, measuring 5 by 7 by 13 inches, and is set by drawing a stout cord, which protrudes from one end. Any weight being placed in the hammock will operate it, so that it works equally well with an infant or a three-hundred-pound person. The period of its operation varies according to the weight of the occupant. The inventor is of the opinion that this device will be of use in the nursery and invalid's room as well as a pleasure for others.

An explosion of mine dust took place some time ago during shot firing in the mines of the Bennett Mining Company near Pittsburg, Pa., and a foreman was killed. As a result of this fatality Superintendent Thomas Oliver is making an experiment with the use of steam in mines to keep down the dust which causes so much trouble. In some dry mines it is the custom to sprinkle the ground with water at regular intervals, but this is not always effective, for the reason that the water thus distributed acts only on the ground, while there are great accumulations of the dust on the ledges and walls of the entries of the mines. Steam pipes are being introduced throughout the Bennett mines, and it is expected that the air will be kept constantly moist by the steam, which will escape from the pipes through openings provided at regular intervals.

A western inventor has contrived a device for which he claims a range of usefulness broad enough to include hygienic as well as outline improvements to the body; in fact, a combined body-ventilating and form-shaping apparatus. It comprises a belt fitted to the waist, and having a sack in front and a buckle at the rear. Tubes extend downward from the sack in position to register with the wearer's legs, and to which the tubes are strapped. Tubular straps pass over the shoulders like suspenders and help support the belt, and also serve as air conduits. The belt is hollow and provided at intervals with openings. A check-valve at the front of the sack permits the entrance of air, a valve tube projecting, and passing through say a buttonhole in the clothing. The sack walls are distended by springs. When the wearer inhales, the inner wall is forced outward, compressing the springs and impelling the air in the sack through the belt and tubes communicating with the sack. All tubes are provided with a series of outlets for the discharge of the jets of air from the belt. The breathing thus effects the release of numerous jets of fresh air over the surface of the person, so that the body is enveloped in a sheet of cool, fresh atmosphere, in excessively hot weather. At this point, care should be taken lest sight of the fact be lost that the refreshment is not all clear gain, since if acquired it must be at the expense of added weight and cumbersomeness of materials at a season when the wearing of articles is rather sought to be reduced to a minimum.

TRIPLE GAGE, BUTT GAGE, AND TOOL HOLDER.

A combined gage and tool holder has recently been invented, which will be found particularly useful for carpenters and cabinet makers. As shown in the accompanying engraving, the device is a very simple one, and yet comprises a great variety of tools. It consists of a block bored to receive two rods, which constitute the triple and mortise gage. Each rod is provided with a marking point at one end. The longer rod extends clear through the block, and is provided at its forward end with a toothed wheel, which is adapted to rotate over the wood without digging in too deeply. The shorter rod is held at any desired adjustment by the thumbscrew, *A*, while the thumbscrew, *B*, serves to lock the longer rod in place. The thumbscrew, *C*, holds an angle plate. The latter serves as a butt gage, and can be adjusted toward and from the marking pin at the edge of the block. This plate is bent over the edge of the gage block, and is formed with a flat cutter. A pin in the gage block just below the shorter gage rod serves as a scribing point. At the center of the gage block is a brad-awl holder, *D*, which may be used for holding various tools. A chisel blade, *E*, is fitted into a slot in the block and held in place by a setscrew, or it may be replaced by the blade, *F*, which will convert the gage into a square. If desired, the gage rods can be removed from the block and replaced by a ratchet screw driver, as shown in Fig. 2, or by some other tool. A patent on this device has been secured by Mr. Phillip Gyssler, 3034 Barber Avenue, Cleveland, Ohio.



TRIPLE GAGE, BUTT GAGE, AND TOOL HOLDER.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

AUTOMATIC VENTILATING APPARATUS.—J. A. HUMMEL, Mount Vernon, N. Y. The invention relates to ventilation, and concerns itself especially with apparatus intended to be used in theaters and similar places. The object is to provide automatically-operated ventilating apparatus simple and reliable in operation. A special purpose has been to provide means for preventing the body of the theater from filling with smoke in case of fire on the stage or in the wings.

TROLLEY-WIRE HANGER.—A. J. LAVERTY, Athens, Ohio. Many advantages are possessed by this invention over the ordinary form. Among these may be mentioned the arrangement of the lugs evenly supporting the clamp-nut and securing a direct and equal pull on the clamp. The projecting ends of the lugs prevent any twisting of the reduced ends of the clamp, even when the greatest force is exerted on the clamp-nut. The clamp may be entirely detached from the hanger. The latter is useful as a splicing-clamp for securing breaks in the trolley wire.

INSULATOR.—T. CARTER, Frankfort, Ky. In this instance the invention relates to insulators admitting of general use, but more particularly to insulators intended to hold wires used in telegraphy, telephony, and the like. The device is of peculiar service to linemen, as it admits of quick and permanent repairs at a small expense.

INSULATOR FOR HIGH-TENSION LINES.—E. GIRAUD, 18 Rue Royale, Paris, France. In the present patent the invention is a divisional application of a former patent, and relates to an insulating apparatus intended for high-tension lines and so arranged or fitted up as to automatically put the line-wire in communication with a discharge or return conductor when the said wire is broken at any point in order that the falling portions of the falling wire shall not be dangerous.

Of Interest to Farmers.

FINGER-BAR.—C. O. WYMAN, Anoka, Minn. The prime object of the inventor is to provide a bar which may be adjusted around its longitudinal axis so as to change the inclination of the bar and sickle with respect to the ground, thus leaving the stubble long or short without changing the elevation of the harvester-platform. The present is a division of Mr. Wyman's former application for harvesters.

WEED-CUTTER.—H. B. NOLEN, Lamar, Wash. This invention has reference to weed-cutters such as used on farms for cultivating fields. The object of the invention is to produce an implement of this class which is of simple construction and provided with a plurality of cutters the position of which may be readily adjusted.

MOTOR-PLOW.—J. W. MCGUIRE, Joliette, N. D. The plows proper are arranged in gang in a frame of peculiar construction, which is connected with the motor proper, the plows being in a line inclined or oblique to the axle of the motor, so that one works slightly in advance of or in rear of the adjacent one. Each plow is adapted for independent adjustment vertically not only as a whole or bodily, but also at the point and heel, so that its pitch may be varied as required for entering the soil or running at different depths therein.

GRAIN-SEPARATOR. — A. MCRAE, Pendleton, Ore. The separator commences to separate grain from the straw under the cylinder, and continues such operation the full length of the machine, and by reason of the chain web running over the arched bottom of the separator such arrangement admits of the long separation and materially assists in said separation, and furthermore, by running the web over the arched bottom and by reason of being held in place by slide-guides it does the work perfectly and admits of the long separation.

Of General Interest.

WHIP - HOLDER. — L. MILLER, Saratoga Springs, N. Y. The object in this improvement is the provision of a holder which will shape and retain the form and shape of whips and which will also embody the desired features of simplicity, durability and convenience. It does away with the necessity of tying or knotting the lash and at the same time imparts a curve of the gooseneck form so difficult to give to the upper portions of a whip.

HORSESHOE - CALK. — O. J. HENNEBEUL, Wilkes-Barre, Pa. One purpose of the invention is to provide a continuous and marginal calk and a construction of horseshoe to which the calk is adapted and to so form said factors that they will be simple and economic and so that the calk can be readily applied to the shoe or removed therefrom by one of ordinary intelligence.

CALIPERS.—A. S. KOCH, Lancaster, Pa. This implement is of the so-called "figure-eight" class employed by watchmakers in testing balance-wheels, and other parts, the object being to provide a caliper with a novel form of pointer and the means for mounting the pointer, whereby it may be readily turned to one end or the other of the caliper and also turned from the plane of the caliper.

SIPHON-COLLAR.—C. R. SCHULTZ, Murray Hill, N. J. In this patent the invention has reference to siphon-collars, the more particular object being to provide an arrangement to avoid any danger of breaking. The two-part siphon-collar by distributing the strain not only upon an annular bead, but also in a measure throughout the substance of the glass immediately adjacent thereto, prevents the possibility of undue breakage in case any part of the apparatus should receive a jar or blow.

DEVICE FOR SPLITTING STONE.—J. F. COPPS, Alberene, Va. In splitting off a horizontal slab the wedges are arranged to operate at the opposite ends of the adjacent drill-holes, so that one wedge will operate in the extreme inner end of its drill-hole and the wedge in the next drill-hole will be at the outer end of its drill-hole, and so on throughout the series, so that splitting action is exerted at the opposite ends of the adjacent drill-holes, whereby an even lifting action on the slab which it is desired to split from the body of rock is obtained, and the line of division will be approximately horizontal throughout.

METHOD OF SPLITTING STONE.—J. F. COPPS, Alberene, Va. The method consists in forming a series of holes having generally the same direction longitudinally and arranged in approximately a common plane, the holes extending nearly through the body of stone to be split, and subsequently exerting a splitting force in the direction in which it is desired to separate the stone, such force being exerted in the extreme inner or closed ends of some of the holes and in the extreme outer or open ends of some adjacent holes whereby to secure a splitting of the body of stone in approximately a straight plane.

SEWER AND CULVERT MOLD.—H. BESSER, Alpena, Mich. The principal objects of the inventor are to provide for adjusting the parts of a mold so as to permit sewer and culvert sections of different sizes to be molded in the same mold, and to provide means whereby all sides except one can be formed by the usual molding process against the surfaces of the mold and the other side by the use of a trowel moved along the edges of two sides of the mold, and to provide mold parts permitting the ready disassembling thereof and provide for easily setting up the molds and securing their several parts together.

APPARATUS FOR CONDENSING GASES.—S. T. MUFFLY, Philadelphia, Pa. One object of the inventor is to provide an efficient, rapid, and relatively inexpensive combination of apparatus for dissolving gases or solid particles carried by gases in any desired solution, it being more particularly desired to provide an apparatus having above characteristics for recovering hydrocyanic-acid gas given off during operation of cyanid processes, and more particularly in connection with the process of extracting precious metals from ores described and claimed by Mr. Muffly in a former application for a United States patent.

Hardware.

STOCK AND DIE.—M. G. CORNELL, JR., New York, N. Y. Of the purposes of this invention one is to provide a construction wherein the die is provided with openings in its side edges leading directly to the threaded aperture for reception of the article to be threaded and wherein the socket of the stock receiving the die is provided with corresponding openings, enabling a lubricant to be readily introduced through said openings to the cutting-threads of the die where they are in engagement with the article being threaded.

Heating and Lighting.

HYDROCARBON-BURNER.—W. KEMP, Tucson, Ariz. Ter. In this improvement Mr. Kemp seeks to produce a burner wherein the inflow of air and of liquid or gaseous fluid is regulated independently of each other, to the end that an intense or modified heat may be secured and regulating means are normally under the control of an attendant, such burner involving small expense in installation and repairs. It constitutes a division of a prior application filed by the inventor.

Household Utilities.

COOKING-STOVE. — E. C. COLE, Chicago, Ill. The invention is an improvement in cooking-stoves, and relates particularly to the construction of the upright grate-front and of the broiler for co-operation therewith. Mr. Cole finds in practice by constructing the grate-front with the openings or spaces between the grate-bars narrowed or contracted at the upper portion of the grate the boiler may be set upright, and uniform results secured.

CURTAIN-LOOPER.—J. W. HENSON, New York, N. Y. This invention pertains to improvements in means for looping or draping curtains, particularly lace curtains, the object being to provide in connection with a curtain a draw-string so arranged that the body portion of the curtain may be looped or folded from the border outward, thus leaving the inner edge of the border in full view from the top to the bottom.

SCREEN.—W. O'BYRNE, Port Chester, N. Y. This screen is of the kind that is placed in the windows of buildings to prevent the entrance of insects. More specifically, the invention relates to that type of screen which is attached to the casement and to the sash and which extends itself automatically, as it were, to fill the open space at the window. The object is to provide an arrangement for attaching such screens to the sash and to the casement, to the end that the screens may be removed or replaced with the greatest facility.

WINDOW-SHADE FIXTURE.—W. D. HARPER, Loco, Indian Ter. This fixture comprises special means whereby it may be readily applied to window-frames of varying widths between the inner side faces of the stiles and also comprises two special bracket members from which the shade-roller is supported through the intermediary of a specially-constructed detachable member co-operating with the bracket members. The improvement may be readily applied and again removed without in any way marring the outer surface portion of the stiles or upright members of the window-frame.

Machines and Mechanical Devices.

ORE-SEPARATOR.—A. PERRY, Caribou, Col. The object of this invention which relates to screening-machines for separating finer from coarser materials, is to provide a separator for treating dry or wet ores to separate the finer from the coarser in a very quick, simple and effective manner without danger of the coarser materials clogging the meshes of the screen.

MACHINE FOR CLEANING FIBER.—W. A. ADAMS, Winchester, Ky. One end of a bunch of hemp is cleaned, withdrawn and then reversed to clean the other end. The invention consists of a novel construction of machine for doing this and also in the combination therewith of an air-blower which acts upon the hemp between the period of its protrusion into the machine and the period of its withdrawal, whereby two important results are obtained, one of which is to loosen up and thrash about the hemp by this blast of air while in the machine and between two distinct operations of the machine on the fiber and the other of which is to prevent the fiber from wrapping around the drum or its journals.

BALING APPARATUS.—F. P. ELLIS, Messer, Kan. In the present patent the invention has reference to baling apparatus, and has for its principal object the provision of an efficient machine for compressing and securing or tying bales of material. A casing furnishes a chamber in which the bale is formed, this preferably having closed top and bottom walls, while the sides are open for a considerable distance to permit the passage of tie-wires.

SAND-BLAST MACHINE.—C. A. P. HESS, 5 Avenue de l'Opéra, Paris, France. In certain machines, one and the same current of compressed air sucks the sand and at the same time projects it against the surfaces to be scraped or cleaned. There is thus produced within the projector an agitation or eddy due to the fact that the operations of suction and projection of the sand are simultaneous and not distinct and successive. By reason of this energy of projection does not correspond with the pressure of the compressed air at the generator. The invention obviates this defect.

CENTRIFUGAL CREAM-SEPARATOR. — Z. L. TRUESDELL, Camden, Ind. Centrifugal action effects the separation of milk and cream, the heavier particles circulating outward and passing upward between the inner and outer sections to be discharged at the skim-milk outlet, while the lighter or cream particles accumulate toward the center of the bowl and pass upwardly, surrounding the feed-tube, but not in contact with it, and into the eccentric bore of inner section of the skimmer-cone and thence out of the discharge, being controlled by a screw-valve.

PNEUMATIC DRILL.—H. BROUSSEAU, New York, N. Y. In this invention there are four cylinders and four pistons, the latter being driven by air, which is admitted continuously through a single rotary valve. The four pistons turn four stub-shafts and the latter are provided with gear which all mesh with a single large gear which is rigid upon the shaft to be driven. The revoluble parts are as far as possible supported in ball bearings.

SEWING-MACHINE.—W. JASPER, New York, N. Y. The machine allows for work on hats having a wide brim, so that wire or the like or braids or other trimmings may be stitched to the brims not only at the outer edge but at a point at or near the crown, and the invention provides means whereby a wire or the like may be secured to the hat by a stitch staggered across the wire from one side to the other. This allows uncovered wires to be secured to the hat, and it avoids the necessity of stitching through a reed, cord, or covered wire.

STAMP - AFFIXING APPARATUS. — J. SCHIMMEL, JR., Olean, New York. In the present patent the invention has reference to apparatus for affixing adhesive stamps to such objects as mail-matter, and has for its principal objects the provision of effective means for accomplishing this end with a mimimum of manual intervention. The base of the apparatus serves as a support for the object which is to be stamped.

TIME CHECK OR RECORDER.—L. M. SORBE and E. E. BROWN, Oklahoma, Oklahoma Ter. This inventor seeks to provide a machine for time recording in which means are provided for quickly and effectively making the proper record on the strip or sheet, moving the said sheet along after each entry to expose a new surface for the succeeding entry, and in which means are also provided for perforating the sheet between each entry, so that each entry may be separated from the other and filed away for proper reference.

Medical Appliances.

TRUSS.—H. BAGON, New Comerstown, Ohio. In this improvement in trusses the perineal band retains the pad in firm contact with the hernia, and the pressure may be varied by using a spring of the proper tension. By means of the hinged plate the truss may be placed in position on the body and the pad afterward adjusted to proper position, and the spring can be made to conform to the position of the pad, since it is pivoted to the plate. The pads may also be made interchangeable, pads of different shape being provided for the same frame to meet different shapes and varieties of hernia.

OBSTETRICAL FORCEPS.—L. G. BARTON, Willsboro, N. Y. In this instance the invention has reference to obstetrical forceps, and more particularly to those of the axis-traction type. Its principal objects are the provision of such an instrument which may be readily applied to the head and efficiently manipulated to effect delivery.

Prime Movers and Their Accessories.

GOVERNING MECHANISM.—J. G. CALLAN, Lynn, Mass. The object of this inventor is to provide a governing mechanism of improved construction which will regulate the amount of motive fluid supplied to the motor under normal conditions and which will shut down the motor irrespective of the position of the regulating valve or valves when the speed exceeds a certain predetermined limit.

OSCILLATING-PISTON ENGINE.—J. BERGESEN, New York, N. Y. This invention refers to a peculiar form of oscillating-piston engine useful in connection with fluid under pressure. It is especially designed as a steam steering-gear for marine wheels. It belongs to that class in which a quadrant-shaped cylinder is provided and a wing or piston arranged to swing in the same. The journal on which the wing is carried is provided with steam-ports and a valve coacting with the ports being engaged with or mounted on said journal or stem. The object is to improve the valve, so as to render action of the engine more certain and rapid than heretofore, and to avoid loss of steam and difficult operation.

OSCILLATING VALVE FOR STEAM-ENGINES.—T. V. ELLIOTT, New York, N. Y. This invention relates to the two-cylinder type of reciprocating engines; and its object is to provide a new and improved valve for controlling the admission and exhaust of the motive agent to and from the cylinders in a very simple manner and without danger of leakage of the motive agent.

Railways and Their Accessories.

CAR - COUPLING. — J. HOUSHOLDER, Big Chimney, and J. C. GALBREATH, Charleston, West Va. The coupler is designed especially for use in connection with mine-cars. The principal objects are to provide a simple automatic coupler of such construction as will admit of dispensing with the usual draw-bar-and-link coupling and allow the coupling to be effected on curves equally as well as on straight lines.

APPLIANCE FOR RAILROAD-CARS.—G. E. HANES, Gunnison, Col. The aim of the improvement is to provide an appliance for use on cars to permit easy, convenient, and quick removal of worn-out or broken journal-brasses and replacing of the same by new ones or to allow of holding a broken car-wheel against turning when it is desired to side-track the car for repairs of the broken car-wheel.

SAFETY-BRIDGE LOCK.—H. ALSOP, Chicago, Ill. The invention relates to improvements in locks used on stock-cars, such as illustrated in a former patent granted to Mr. Alsop, and has for its object to produce a simple, cheap, and efficient locking device to retain the safety-bridge in its vertical or closed position.

BALL-BEARING.—J. N. PETERSEN, New Orleans, La. In this patent the object of the inventor is the provision of a new and improved ball-bearing arranged to relieve the bearing of jars and jolts incident to end thrust, to prevent jamming or crowding of the balls by allowing sidewise play thereof, to render the bearing dust-proof and oil-retaining, and in case the bearing is applied to rolling-stock of railroads to lessen the friction of the wheel-flanges against the outer rail when running around sharp curves. The bearing will efficiently serve the purpose for which it was designed, its construction being very successful for railroad rolling stock and for all heavy duty, where it is desirable to reduce friction.

LUBRICATING DEVICE.—W. H. PROCTER, Loco Buildings, Khurda Road, Jatni, Bengal, India. In the present patent the invention has reference to improvements in lubricators for bearings, cranks, shafts, slide-blocks, eccentrics, and other moving parts, and has for its object the thorough lubrication of the bearing-surfaces. The device may be applied to existing machinery

Pertaining to Recreation.

AMUSEMENT DEVICE.—W. F. MANGELS, New York, N. Y. This invention refers to pleasure-railways; and its intention is to provide a new and improved amusement device

for use in parks, pleasure-resorts, and other places and arranged to give an exciting ride to the occupants of the car and to afford considerable amusement to the onlookers.

BOWLING-SLIPPER.—W. J. BARNETT, New York, N. Y. One purpose of the invention is to provide a slipper for the heel of a shoe which can be readily carried in the pocket and whenever required may be conveniently and expeditiously applied and secured and as readily removed, and also to provide the heel-slipper with an effective attaching medium to effectually hold the slipper in place under all conditions of usage, but which will in no manner interfere with the muscular play of the foot.

MERRY-GO-ROUND.—J. L. ARIZTIA, Iquique, Chile. This invention is an improvement on that class of apparatus which include a circular rotatable platform carrying horses or other quadrupeds ridden by persons. Mr. Ariztia has devised an improvement in which a series of annular platforms or rails is substituted for the ordinary rotatable platform, the same being supported and adapted to travel circularly on flanged rollers fixed on horizontal shafts radiating and driven from a common center.

Pertaining to Vehicles.

WAGON-BRAKE.—T. N. JOHNSEN, Wilbur, Wash. The operation is entirely automatic. Moving on level ground, the relation of parts is unchanged; but on starting down an incline the bed tends to swing forward when spring-supported or to roll forward when on the rollers, rocking the rock-shaft and drawing the brake-beam to the rear, thus pressing the shoes against the peripheries of the wheels. As soon as level ground is reached the bed swings or rolls back, rocking the rock-shaft in the reverse direction, releasing the brake-shoes. Means are provided to regulate the power of the brake.

VEHICLE-BODY.—W. D. McNUTT, Upper Sandusky, Ohio. While relating generally to improvements in wagon-bodies, the invention more particularly seeks to provide an improved construction of "storm-wagon" body which while useful for the ordinary purposes of light wagons is more especially designed for use for those who have to ride more or less through rough weather, like mail-carriers, parcels-delivery carriers, etc.

COOLING APPARATUS.—D. McR. LIVINGSTON, New York, N. Y. The invention relates more particularly to cooling apparatus employed in connection with motor-vehicles propelled by explosive-engines. It has a wider field of usefulness and may be embodied in a condenser or heating apparatus. In coolers of this character walls are provided having such a conformation and such a relation to each other as to produce when assembled conduits for the passage of water or other fluid to be cooled and passages at approximately right angles to the conduits for passage of atmospheric air or other cooling fluid.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9995) B. T. asks how to make buff wheels. A. Turn up the wooden disk to form the wheel on the mandrel on which it is to run. Cover the periphery of the wheel with good glue, prepared as for gluing wood, stretch the leather around and confine it with shoe pegs driven in about 2 inches apart. When dry turn off true with a sharp chisel. Give the leather a coat of glue and roll it in emery, so as to make it retain it by being imbedded in the glue. Let the wheel dry until the glue is hard and it is ready for use.

(9996) C. L. F. asks how to preserve bird-skins. A. Make an incision from the breastbone to the vent; with a small piece of wood work the skin from the flesh. When the leg is reached, cut through the knee joint and clear the shank as far as possible, then wind a bit of cotton wool on which some arsenical soap has been put round the bone; do the same with the other leg. Now divide spine from root of tail, taking care not to cut too near the tail feathers, or they will come out. Next skin the wings as far as possible and cut off. The skin will now be entirely clear of the body. The skin must now be turned inside out and the neck and skin gently pulled in opposite directions till the eyeballs are fully exposed. The whole of the back of the head may be cut off and the eyes and brains taken out and their places filled with cotton wool. The whole skin should be rubbed well with arsenical soap or plain arsenic, and the neck returned to its natural position, when, after filling the body with a little dry grass or wool, the job is done. It is very easy, and the skin of a bird is much tougher than one would suppose, though, of course, they vary, the night-jar being very thin, while humming birds are fairly tough. All the apparatus required is a sharp knife and a pair of scissors, or, for large birds, a strong pair of nippers to divide the bones.

(9997) C. N. asks how to destroy weeds. A. 1. The best way, says a correspondent, to apply salt to paths, to destroy weeds, is as follows: Boil the salt in water, 1 pound to 1 gallon, and apply the mixture boiling hot with a watering pot that has a spreading rose; this will keep weeds and worms away for two or three years. Put 1 pound to the square yard the first year; afterward a weaker solution may be applied when required. 2. The plants should be cut off close to the ground and a few drops of coal oil poured on to the crowns. They immediately commence to decay and are utterly destroyed. Troublesome weeds on the lawn can thus be speedily disposed of, but others will likely take their place.

(9998) J. N. A. asks for formulas for writing on zinc. A. 1. Mix verdigris, 1 part; sal ammoniac, 1; chimney black, or any mineral color, ½; water, 10; stir well or shake the bottle before employing, and use a quill, not a steel pen, for writing. This ink is a poison. 2. Get a lemon, squeeze the juice out of it into a pot, and put into it an old copper cent or piece of copper, not the present bronze coin. Let it stand for a day or two. Write with a quill pen. 3. Dissolve 100 grs. of chloride of platinum in a pint of water. A little mucilage and lampblack may be added.

(9999) C. L. asks how to lace belts. A. The ends of a belt should always be cut off square, not guessed at by the eye, but laid off with a tool. The holes ought to be made with a small punch at a proper distance from the end; the size of the holes and the distances of them depending on the width of the belt. The use of an awl is reprehensible, for the holes are apt to be made irregular by it, and much larger than there is need of. The end of the lace should be tied with a square knot in the middle of the outside, for the corners of the belt where it is cut are most exposed and apt to whip out. Tying a belt lace does not look so neat as where the ends are put through an incision, but tying saves the belt from having extra holes made in it. The laces ought to be of the same thickness from end to end, or as nearly so as possible. It often happens that laces have very thin spots in them; such should be kept for short belts, and never used for long ones. Moreover, the holes must be made at equal distances apart and not too many of them. Every hole weakens the belt, and none that are not absolutely essential should be cut. All new laces, as well as new belts, should be stretched by hanging weights on them before they are used; petroleum, sawdust, resin, and similar substances should never be used. When a belt gets harsh or dry, neat's-foot oil is the best thing to apply to it.

(10000) C. W. asks: Please explain the following phenomenon. I had occasion to use an electric light bulb, and I observed that whenever I touched it in a dark room with my hand it became luminous. I found that the filament was not luminous, and that the luminosity occurred when it was touched by the flesh or other soft objects, and also when rubbed by them. If the bulb was moist, the phenomenon did not occur. A. All glass tubes or bulbs in which there is a vacuum of the right degree will glow in the dark when near an electrified body, as you have observed in the case of the lamp bulb. The static electrical charge is probably the cause of the glow.

(10001) C. M. S. asks: 1. Why does not an arc lamp short-circuit a current or cause a live wire, the same as when the two wires leading from the generator are touched together and pulled apart, thus making an arc? A. The carbons of an arc lamp do not short-circuit the current because the resistance of the coils in the lamp cut the current down to the number of amperes needed to light the lamp. 2. Is there any form of a rheostat used in the ordinary arc lamp? A. There is a rheostat in all arc lamps. 3. Please send me one of the SCIENTIFIC AMERICAN SUPPLEMENTS showing the construction of an electric furnace. A. Our SUPPLEMENT 1182 contains a good article upon the construction of an electric furnace.

(10002) M. G. F. asks: Will you state through Notes and Queries how a plate of glass should be shaped or cut so as to reflect the colors of the rainbow from the sun's rays without any water being used? I have seen, apparently, a flat glass reflect a rainbow on a screen or background when no water was present. A. If two glasses are placed one upon another and slightly pressed together, there will frequently be small circular rainbows, which may be projected upon a screen by a lens. No water need be used. The glasses for this purpose should not be very smooth or fit each other very closely. Wright's "Optical Projection," price $2.25, describes the mode of arranging to show these rings, under the title Newton's rings.

(10003) J. E. S. asks: 1. How can one tell the positive terminal of a dynamo? A. The best way to tell the positive pole of a dynamo is by an instrument called a pole tester. These can be had from dealers in electrical goods, for which see our advertising columns. 2. In a compound-wound direct-current dynamo does the current on leaving the positive brush flow through the series field, thence through the external circuit to the negative brush, or does it on leaving the positive brush flow through the external circuit and then through the series field winding to the negative brush? A. It makes no difference whether the series field of a compound-wound dynamo is connected to the positive or the negative brush and the external circuit. 3. On a compound-wound "Wood" Fort Wayne alternator the name plate reads thus: "K. W. 75. Poles 16. R. P. M. 1050. Volts no load, 2,000; full load 2,200. Amps. full load, 35." The machine is now run at 550 R. P. M., generating current at 1,060 volts, and the peak of the load is 31 amperes. The machine heats considerably. What causes it, and what is the full load at that speed and voltage? A. For the cause of the heating of your alternator you would better address the company which made the machine. Their engineer can give you the advice needed.

(10004) K. G. C. asks: Owing to the precession of the equinoxes, is the apparent diurnal motion of Polaris around the pole of the northern celestial sphere describing now a larger or a smaller circle than formerly, or in other words, is the star approaching or receding from the actual pole? A. At present the distance of Polaris from the North Pole is about one and a quarter degrees. At the time of the Star Catalogue of Hipparchus, it was 12 degrees distant from the pole. It will approach the pole for the next hundred years, at which time it will be within a half degree of the pole. After that time it will recede from the pole, or rather the pole will recede from the star.

(10005) S. asks: Since the recent earthquake in California, many questions have arisen regarding earthquakes and their effects on buildings. If you will publish an opinion on the following one, you will oblige many of us: In the case of earthquake, where is the greatest oscillation—at the top of buildings, or at the base? A. If a building is overturned by an earthquake, the top moves farthest. If it is not overturned, we should suppose the bottom would move farther than the top. Inertia would hold the top still, while the sudden motion of the earth would move the bottom. This is often seen in monuments in cemeteries. See illustrations on motions of cemetery monuments in SCIENTIFIC AMERICAN, Vol. 94, No. 20. The base moves away from the upper part of the monument.

(10006) C. M. asks: 1. Can you give me any advice how to vulcanize bicycle tires? A. The process of vulcanizing rubber is described in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 251, 252, 781, and 895, price 10 cents each by mail. 2. Will a fan motor, having permanent magnetic fields, need the same number of batteries to drive it, as the same motor with electro-magnet fields? A. The power is less with permanent magnets by the small amount of current to magnetize the field, of course. 3. Is telephoning allowed during a thunder storm, and why are the lights turned on during the same on a trolley car? A. The telephone exchanges do not cut off subscribers during a thunder storm. They depend upon the lightning arresters for protection. For the same reason the trolley service is not interrupted. Once in a while a burn-out occurs, but very rarely in comparison with the number of telephones and cars. Lamps are only lighted when it is dark enough to require their light.

(10007) W. W. S. asks: Does a piece of iron have more or less cubical contents when magnetized? I have tried to find out by using water and hair tubes, but I can see no change whatever. A. We should not expect to demonstrate any change in contents of an iron bar by magnetizing it. The change is of an infinitesimal order at the largest. The question has at most a theoretical interest. According to theory, the molecules are turned with their lengths in the same direction while the magnetizing current flows. They occupy no more space in this condition. We should, therefore, think that the bar as a whole would occupy no more.

(10008) L. C. S. writes: 1. As I understand it the resistance is what makes the field coil get hot. In order to avoid the heating more wire is added; now, if resistance is what heats the coil, how do you account for the coolness of the fields after adding more wire, consequently more resistance? A. Your statement that resistance causes the heating of an electric circuit is less than half right. The exact statement is that the heat developed in a circuit is directly proportional (1) to its resistance in ohms, (2) to the square of the current in amperes, (3) to the time that the current flows in seconds. Now one ampere flowing through one ohm develops 0.24 calorie in one second. Putting these facts in a formula we have: Heat in calories $= 0.24\ C^2Rt$. It can now be seen why the heating of a coil can be remedied by adding more wire. The increase of resistance cuts down the amperes in the same ratio as the increase. But the reduction of the amperes affects the heating power in the ratio of the squares of the amperes. Thus, if the resistance were doubled the amperes would be halved, but the heat produced would be reduced to one-fourth of what it was, since the square of ½ is ¼. 2. What is the cause of the humming in the field coils and pole pieces of an induction motor when the armature does not revolve, but the current is passing through the fields? A. The alterations of an electric current produce vibrations which are heard as sound. These can be heard near an arc light run by an alternating current, or near an alternating electro-magnet. 3. What changes are necessary to reverse the running of an induction motor? Crossing the positive and negative wires at the binding posts will not do it. A. Of course, merely reversing the main wires will produce no effect upon the direction of rotation of a motor. If the induction motor is two phase, the direction of rotation will be reversed by changing the two leads of either phase. If it is three phase, it will be reversed by changing any two of the leads. The different phases are a fraction of a period behind each other, and the direction of rotation depends upon the direction in which the phases lag behind around the rotating part of the motor, whether clock-wise or contra-clockwise. To reverse the motor the direction of the lag in phase must be reversed. 4. Would it be possible to illustrate and explain the induction motor in the SCIENTIFIC AMERICAN some time in the future? A. The induction motor has been fully treated in several books recently published: Oudin's "Polyphase Apparatus," price $3 by mail; Thompson's "Polyphase Currents," price $5 by mail. These, with Thompson's "Elementary Lessons," price $1.40, will put you in possession of quite a complete library of the subject at present.

(10009) C. B. M. writes: I have a small motor which has a magnet in place of field winding. An electrical engineer told me if I put it on a large machine it would give greater power. I did so, and it does not give any power at all. It will run without a load, but will not run backward when current is reversed as it did before. A. A motor requires the proper current, that is, a current of the number of volts for which its winding was made. It will then develop under this pressure the power it was intended to yield, for the reason that it will take the proper number of amperes from the line. A current less than this will not run the motor up to its limit, one greater than this will overheat its coils. It would appear that you must have put the motor upon an alternating current, when it was intended for a direct current, since it would not reverse nor develop power.

(10010) E. H. W. writes: I read with much interest the article of M. Tommasina's automatic coherer," in your issue of June 16, 1900, page 376, and would like to ask if it is

not possible that the decoherence of the carbon particles after the spark has passed may not be due to the return of the iron diaphragm in the telephone receiver to its original position, as there is a perceptible jar due to the vibrations in a receiver on both making and breaking the circuit. A. The vibrations of a telephone diaphragm can hardly have energy enough to effect the decohesion of the particles mechanically. The point could, however, be determined by placing a coherer containing metallic powder in the same position. If it will work as well as the carbon coherer, it would justify the theory of our correspondent.

NEW BOOKS, ETC.

THE SEVEN FOLLIES OF SCIENCE. A Popular Account of the Most Famous Scientific Impossibilities and the Attempts which have been made to Solve Them. By John Phin. New York: D. Van Nostrand Company, 1906. 12mo.; 178 pp.; numerous illustrations. Price, $1.25.

The author in this work has produced a book that will undoubtedly appeal to the popular mind as well as to that of the scientist. He has endeavored successfully to give a simple account of the problems which have occupied the attention of the human intellect ever since the dawn of civilization, and which will continue to interest for ages to come, primarily because many of them cannot be solved despite apparent simplicity. To-day we advance so rapidly in almost every field of endeavor that it is difficult to believe that there may be such a thing as a scientific impossibility, but that this exists is undoubted, and the author shows where the line must be drawn.

JAHRBUCH FÜR DAS EISENHÜTTENWESEN. (Ergänzung zu Stahl und Eisen.) Ein Bericht über die Fortschritte auf allen Gebieten des Eisenhüttenwesens im Jahre 1903. Im Auftrage des Vereins deutscher Eisenhüttenleute bearbeitet von Otto Vogel. IV. Jahrgang. Kommissionsverlag von A. Bagel. Düsseldorf, 1906. 8vo.; 464 pp.; illustrated. Price, $4.

This book is gotten up with the thoroughness which we so often properly associate with the German scientist. It is an account of practically all the advances and developments which were made in the iron industry in the year 1903, in Germany as well as in other countries. In it are given numberless references to articles written by experts and dealing with various phases of the subject, in technical publications the world over. It contains further a series of articles on various innovations, which are supplied with excellent illustrations to supplement the text.

TYPE AND DETAILS OF BRIDGE CONSTRUCTION. Part II. Plate Girders. Examples of Constructed Railroad and Highway Spans. By Frank W. Skinner, M. Am. Soc. C.E. New York: McGraw Publishing Company, 1906. 8vo.; 412 pp.; illustrated. Price, $4.

This excellent work is a thorough and comprehensive review of the American practice in plate girder construction for bridge and other work. Many of the chapters are based on earlier writings of the author published in technical periodicals, to which he has been a contributer for the last fifteen years. Examples of early work are given to show the development of designs corresponding with the growth of the requirements, the development of engineering practice, and the change from wrought iron to steel. The examples of the various types discussed and illustrated fully cover the range of dimensions, capacities, and types for the different positions and requirements under which plate girders are used for bridge work. The descriptions are precise, and clearly present many special and important features of design.

HIGH-TENSION POWER TRANSMISSION. Second Volume. A Series of Papers and Discussions Presented at the International Electrical Congress in St. Louis, 1904. New York: McGraw Publishing Company, 1906. 8vo.; 315 pp.; illustrated. Price, $2.50.

This book is based upon a series of papers and discussions presented at the International Electrical Congress in St. Louis in 1904, and will be found to give the best practice as laid down by the recognized authorities, American and foreign. It is published under the auspices of the Committee on High-Tension Transmission of the Electrical Congress. The papers upon which this book is based were generally developed from practical experience, and as such are of great value to the engineer interested in this subject. They cover many phases of the subject from various points of view, and while in some directions they present difference of opinion on the same question, in others are remarkably unanimous.

MOTOR-CAR MECHANISM AND MANAGEMENT. Part I. The Petrol Car. By W. Poynter Adams, M. Inst. E. E. Philadelphia: J. B. Lippincott Company, 1906. 12mo.; 174 pp.; 22 illustrations. Price, $2.

It is undoubtedly true that a practical knowledge of the mechanism of the motor car cannot be obtained simply by the reading of a textbook, no matter how excellent this may be. As the author states, it is the intention in the present work that the information contained in this book shall be supplementary to practical instruction, and as such it will prove of undoubted value. He avoids the use of technical expression and scientific phraseology, and the text will be readily comprehensible to the uninitiated in the mysteries of mechanism. The illustrations have been carefully designed to enable a reader not familiar with mechanical drawings to understand them.

JAHRBUCH DER SCHIFFBAUTECHNISCHEN GESELLSCHAFT. Berlin: Verlag von Julius Springer, 1906. 4to.; pp. 715.

This beautifully bound and illustrated publication is the seventh volume of the Proceedings of the German Society of Naval Architects and Marine Engineers. It covers the spring and autumn meetings of 1906, and contains a number of original papers covering a wide range of subjects, which are not only of interest to members, but will be found worthy of reading by engineers the world over. Several of the papers are discussed by the members. The Emperor of Germany is a patron of the Society, and its flourishing condition is evident from the large membership, which now includes over 1,100 technical men. The papers discuss various phases of marine engineering, both mercantile and naval, and many original theories and deductions as well as practical observations are brought out.

ELECTRIC TRANSMISSION OF WATER POWER. By Alton D. Adams, A.M., M. Am. Inst. E.E. New York: McGraw Publishing Company, 1906. 8vo.; 336 pp.; illustrated. Price, $3.

The subject chosen by the author of this book is to-day unquestionably one of the most important which the electrical engineer is called upon to solve. Electrical supply from transmitted water power is now distributed in more than fifty cities in North America, and the practice of such usage of natural power is constantly growing and developing. Its various phases are discussed by means of examples chosen from the many transmission systems available, and are excellently illustrated by drawings and photographs. The book will be found to contain the best practice for electrical transmitting as developed in this country, from the water power itself to the details of construction, at the end of the transmission line.

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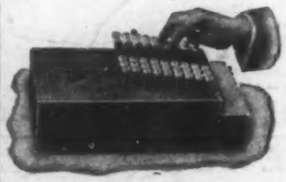

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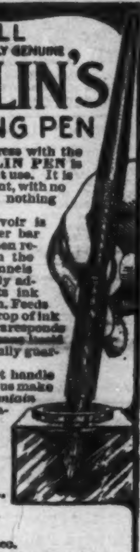

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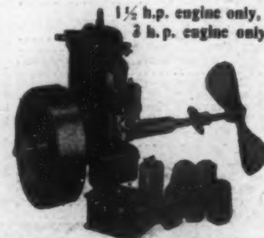

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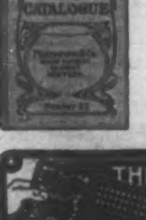

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